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GOVERNMENT OF INDIA

MINISTRY OF AGRICULTURE & IRRIGATION

(DEPARTMENT OF AGRICULTURE)

27

REPORT ON

FOREST RESOURCES OF RAJASTHAN

(UDAIPUR FOREST DIVISION)

VOLUME I

INVENTORY RESULTS



PREINVESTMENT SURVEY OF FOREST RESOURCES

DEHRA DUN

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P R E F A C E

The work in Udaipur Forest Division of Rajasthan was undertaken on the request of Rajasthan Forest Department by the Preinvestment Survey of Forest Resources through its Northern Zone. The field work was started in December 1975 and had to be stopped in March, 1976 for revision of certain objectives. It was restarted in December, 1976 and completed by May 1977.

The main objectives of the survey were finalised after discussions with the State Forest Department. This report is based on the old management maps as the State could not provide the new maps. The inventory results show that about 80,000 m³ of salar (Boswellia serrata) and 46,000 m³ of godal (Lennea coromandelica) are available annually for industrial use. These woods can be used for pencil industry, plywood and to feed some paper mill.

The cooperation and assistance of State Forest Department is gratefully acknowledged. The hard work put in by the Northern Zone staff is appreciated.

(G.L. Bhatia)
Chief Coordinator.

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1. INTRODUCTION

Most of the forest resources of Rajasthan are concentrated in the southern part consisting of Chittorgarh, Udaipur, Sirohi, Banswara and Dungarpur districts. These forests are fairly rich in timber and bamboo resources. Realizing the importance of forests for industrial development, Rajasthan Forest Department started the forest resources survey during 4th 5-year plan. For this purpose a Forest Resources Survey division was opened under Central Govt. assistance. This division completed the survey in Sirohi, Banswara, Dungarpur and Chittorgarh Forest Divisions. A small portion of Udaipur forest division was also surveyed. The survey division was wound up during 1973-74 without completing the survey in Udaipur division. This division is a very big division which accounts for more than 50% forest resources of the southern districts of the State and no planning for forest industries could be of any use unless the resources of this division are known. Therefore, Rajasthan Forest Department approached Preinvestment Survey of Forest Resources Organisation to conduct survey in balance area of Udaipur division. Since only a small portion of the division was surveyed by the Forest Resources Survey division of Rajasthan Forest Department and the survey was also conducted much earlier, it was decided to survey the entire division. The survey work by Northern Zone of Preinvestment Survey of Forest Resources Organisation was started in December, 1975 and completed by end of March, 1977. Special Studies viz., Market & Demand Studies, Volume and Cull Studies etc. however, continued till May, 1977. Since survey work in Himachal Pradesh was also going on simultaneously the field work in Rajasthan was confirmed to winter seasons of 1976 and 1977.

2. A R E A

The survey area comprises Udaipur Forest Division i.e. entire Udaipur district except Bhim tehsil. Total geographical area is about 15,206 sq.kms. out of which forest area is 4548 sq.kms. The survey area lies between $28^{\circ} 46'$ & $28^{\circ} 30'$ North latitudes and $74^{\circ} 30'$ & $73^{\circ} 0'$ East longitudes.

3. CLIMATE

The climate of the area is mostly dry and moderate with prolonged summers. Summers, however, are not as hot as in other parts of the State. The year is differentiated by three distinct seasons, namely - hot season (March to June), rainy season (July to September) and cold season (November to February). Temperature varies from 10°C (minimum) in January and 44°C (maximum) in May. Average rainfall varies from 518 mm to 1308 mm with 42 average number of rainy days.

4. GEOLOGY, ROCK & SOIL

The area is generally hilly with innumerable series of detached hills scattered all over the area except in North-Eastern portion where the land is comparatively plain. Aravalli system dominates the area. However, towards North-West side Mewar banded gneissic complex is met with which is distinctly marked from Aravalli system. Vindhayan formation also appears in southern part covering mostly Bansi, Dharwad and part of Salumber ranges. The geological formations commonly met with are Deccan Trap, Vindhayan Delhi series, Kailo series, Aravalli system and Pre-Aravalli banded Gneiss. Sand stones, lime stones, dolomite basalt, phyllities, gneiss, quartzites etc. are the common rock types found in the area.

There are only two important soil types that occur in the area. These are - Black soils and Red soils. Black soils are mainly developed from Basaltic rock and so pre-dominate over most of the Deccan plateau. Black soils contain high percentage of clay and are characterised by deep and wide fissures in the soil in dry season. These soils are generally alkali in nature, and poor in nitrogen and phosphorus contents but adequately rich in Potash and Lime. Humus content is typically low. Red soils, on the other hand, are mainly associated with acid granities, gneisses and schists and are ferrolitic in nature. They are typically coarse, often with ferric concretions with a neutral or acidic reaction and poor in organic matter and mineral nutrients.

5. VEGETATION

There is a wide variation in the vegetation and its growth from one part to other part of the survey area. In general there is increase in the amount and variety of tree growth from North to South and East to West. Growth is more luxuriant on lower slopes of the hills than near the hill tops. The valleys situated away from villages support quite good forests of fairly tall trees with patches of dense grasses. Northern slopes are generally more wooded and remain green for comparatively longer period during dry season.

Good forests are seen on high quartzites and conglomerate ranges. Although the forests are sometimes swept away by forest fires which burn off all grasses and seedlings, yet these ranges are densely clothed with a variety of species. There is a marked distinction between the vegetation on the Aravalli system and Vindhayan system. Teak is generally confined to Vindhayan ranges and is almost absent on Aravalli hills.

In short, the forests are mainly confined to South, South-west and North-West parts of the district. The composition and quality of forests varies a great deal depending upon the soil conditions, geological formation, topography and the climatic conditions.

6. LAND USE

The break up of the geographical area of the district (except Bhim tehsil) according to different types of land uses is as under:-

(1)	Total geographical area	=	15,206.94 sq. km.
(2)	Forest area	=	1,123.75 "
(3)	Cultivated area	=	3,146.83 "
(4)	Area under tree growth and orchards	=	10.72 "
(5)	Fallow land	=	846.41 "
(6)	Culturable waste	=	4,055.64 "
(7)	Area not available for cultivation	=	6,023.59 "

Source :- Census 1971, Rajasthan - District Udaipur
Table No. 10.

7. INFRASTRUCTURE

Till two decades ago, there were very few all weather roads in the district. In the interior areas like Kotra, Panarwa, Jhadol etc. there were hardly any roads. During last one decade, however, the situation has improved to a great extent and the district is now fairly well placed in the State from communication point of view. Total length of metalled and un-metalled roads is 1041 kms. and 1156 kms. respectively. The railway lines are mostly concentrated in Northern and North-Eastern parts which contains very little forests. South-Western part, which is comparatively rich in forest resources is not connected by railway line. Thus railways do not play any significant role for local transport of forest produce.

8. SOCIO-ECONOMIC CONDITIONS

More than 87% of the population lives in villages. As per 1971 Census, the population density in rural and urban areas respectively is 92 and 1612 persons per sq. km. Population density is very low in Kotra, Falasia and Lasaria tehsils which are very rich in forest resources. The local population chiefly consists of Agriculturists and agricultural labourers which is 76.5% of the total population of the district. There is quite a substantial population of tribals like Bhils, Menas, Garasia etc. In some of the tehsils like Kotra, Kherwada, Salumber, Lasadia etc. population is predominantly tribal. The tribals and scheduled caste constitute respectively 33.66% and 1.76% of the total population of the district. The rural population is mostly illiterate. The literacy percentage in rural area is only 12.69% and for tribals it is even less than 5%.

Rural economy is primarily agriculture based. The agricultural holdings are generally small. Irrigation facilities are generally poor. Tanks and wells are major sources of irrigation. Wheat, Barelly, Maize, Rice, Gram, Sugar-cane and cotton are the main agricultural crops raised in the area. Cattle rearing is another important field which provides livelihood to rural people. Cattle population in the district is almost twice the human population. Cattles are maintained for milk as well as meat.

There is very little industrial activity in the area except in Udaipur town which is developing into an industrial centre rather slowly. There are, however, quite a few cottage/small scale industries working in the area among which toy making industry is, rather, the most prominent. Quite a good quantity of toys are exported not only to other parts of the country but to foreign countries also. Wrightia tinctoria wood is generally used for toy making.

9. FOREST SETTLEMENT

The demarcation of forests and its settlement was first started under the Mewar Forest Act of 1942. The forests were classified as Khalsa, Jagir and Bhomat forests having varied degree of proprietary rights of the Government. After the formation of the Rajasthan State all these forests were brought under the purview of Rajasthan Forest Act and classified as reserved and protected forests. After formation of the Rajasthan State, the State Government also did not recognise any right but very liberal concessions have been granted to local population.

There are 12 ranges in the division. Out of total forest area of approximately 10135 sq. kms. as reported by the Rajasthan Forest Department, only an area of 4199 sq. kms. was brought under scientific management during the currency of last working plan which expired in 1972. As per this working plan, the forest area under reserved, protected and un-classed (surveyed) is 2989 sq.kms., 575 sq.kms. and 635 sq.kms. respectively. Balance area (approximately 5936 sq.kms.) is classified as un-classed (un-surveyed). This report, however, is based in 4548.45 sq.km. forest area, which is compiled on the updated management maps supplied by Rajasthan Forest Department.

10. AVAILABLE FOREST RESOURCES INFORMATION

The first working plan came into being only in 1962-63 and at that time no enumerations were done to assess the growing stock. This working plan expired in 1971-72, but due to non-revision of the plan, the old working plan is still in force. The working plan is now under revision but no enumerations are contemplated even now. The Forest Resources Survey Division carried out survey sometime during 1973, but it covered a very small area and even for this area the data were not processed. There is hardly any sample plot maintained in the division to study the growth etc. Thus, there is no past information available on growing stock, growth rate etc.. Even the reliable forest area information is lacking.

11. INVESTIGATION AND METHODOLOGY

The survey was undertaken primarily to assess the range & working circle-wise total growing stock of important species in the division and after assessing the local requirement of wood, to estimate surplus wood likely to be available for establishment/expansion of wood based industries. The total growing stock of bamboo was also to be estimated.

In order to achieve this objective, a detailed inventory of forest resources alongwith consumption study was undertaken as explained briefly in the following paragraphs.

A systematic sampling of varying intensity from range to range was adopted. The Forest Department supplied forest management maps based on the last working plan and updated by the Working Plan Officer, Udaipur Division, showing the compartments, blocks and ranges. Each 5 minute longitudinal and latitudinal interval on these maps was subdivided into 4 equal parts of $1\frac{1}{4}$ minute. The centres of the sample plots selected were located on the inter-sections of these longitudinal and latitudinal lines at $1\frac{1}{4}$ interval. A square plot of 0.16 ha. size was adopted for sampling and all the trees above 5 cm. D.B.H.O.B. falling inside the plot were enumerated. A detailed information on geology, rock & soil, terrain, degree of slope, vegetation, forest types, regeneration status, biotic interference, diameter height, bark percentage, form factor etc. of trees, diameter height of bamboo culm, clump size etc. was collected. The number of sample plots selected from each range are given below :-

Name of Range	Total number of sample plots
Udaipur	88
Parsad	81
Salumber	59
Kurebar	36
Kherwada	52
Gogunda	38
Bansi	52
Panarwa	52
Jhadol	43
Kotra	40
Dhariawad	44
Kambalgarh	104
Total :	689

In order to derive a relationship between diameter and volume and also to study the hollowness, bark percentage etc. 652 trees were selected randomly for felling and detailed information on diameter, bark thickness, volume etc. was recorded.

For estimating the growing stock of bamboo, the total number of clumps in each plot were counted. The clumps were divided into different size and quality classes. A detailed study of culms regarding their age, size, condition etc. in certain randomly selected clumps was also done.

Present production figures were collected from Annual Administration Reports and other relevant records. A low intensity sample survey was also conducted to estimate the wood consumption by local people for house construction and repairs, agricultural implements and firewood. All the wood based industries in the survey area were also visited and wood consumption by these industries was recorded.

The raw data from field forms were transferred to punch cards with punching machines and the data were processed/analysed with the help of electronic computers.

Note : For details of methodology, Volume II of the main Report may be referred to .

12. THE SURVEY RESULTS

The results of survey are summarised in following paragraphs.

13. FOREST AREA BY FOREST TYPES

The total geographical area of the division is 15,207 sq.kms. The forest area as computed from the management map supplied by the Rajasthan Forest Department is 4548.45 sq.kms. The distribution of forest area by different forest types is given below.

Table No. 1

S.No.	Forest Type	Percentage area	Area in Sq.kms.
1.	Teak type	7.82	355.822
2.	Dhok type	0.39	17.809
3.	Salar & Godal type	45.31	2060.998
4.	Mixed Misc. with teak type	11.10	505.133
5.	Mixed Misc. without teak type	31.61	1437.480
6.	Others	3.77	171.204
	Total	100.00	4548.446

14. BIOTIC INTERFERENCE

The forests are prone to biotic interference by way of grazing, fires, lopping, hacking etc. The area under different categories of biotic interference is given below. It may be seen that very large area is affected by biotic interference and only 12% is comparatively under normal biotic interference.

Table No. 2

	Biotic interference	Percentage area	Area in sq.kms.
1.	Very heavy	14.78	672.171
2.	Heavy	26.21	1192.219
3.	Moderate	47.08	2141.590
4.	Light	11.93	542.466

REGENERATION STATUS

The status of natural regeneration has also been studied. The area under different regeneration categories is given below. The condition of forests from regeneration point of view is far from satisfactory. The regeneration over an area of 8% only may be called satisfactory.

Table No. 3

S.NO.	Regeneration Status	Percentage area	Area in sq.kms.
1.	Profuse	1.19	54.341
2.	Adequate	7.01	319.105
3.	Scanty	41.11	1869.526
4.	Nil	50.69	2305.474

16. FOREST POTENTIAL

Such areas where density of forests cover is less than 0.4 but the nature of vegetative cover and soil condition indicate that site can support much better forests, have been identified and called potentially productive forests. About 1480 sq.kms. of the forest area comes under this category. This area can conveniently be taken for clear felling and afforestation with suitable species.

17. TREE VOLUME STUDIES

The relationship between diameter and volume of different species is expressed in the form of volume equations and same are given below :-

<u>Species</u>	<u>Equations</u>
<u>Tectona grandis</u>	$V = 0.062108 - 0.927983D + 6.613031 D^2$
<u>Boswellia serrata</u>	$V = -0.155316 + 2.714875 D$
<u>Lannea coromandelica</u>	$V = 0.046731 - 0.962906 D + 7.301883 D^2$
<u>Mogeissus latifolia</u>	$V = -0.004378 + 4.575823 D^2$
Rest of species	$V = 0.081467 - 1.063661 D + 6.452918 D^2$

Where -

V = Under bark tree volume (m^3) upto a limit of 5 cm. over bark diameter.

D = Over bark diameter (m) at breast height.

The percentage of hollow trees by species and diameter classes is given below :-

Table No. 4

<u>Species</u>	<u>Diameter (O.B.) in cm.</u>					
	5-10	10-20	20-30	30-40	40-50	50+
<u>Mogeissus latifolia</u>	3.7	13.2	31.9	54.7	81.9	-
<u>Lannea coromandelica</u>	0	0	1.7	4.8	7.4	-
<u>Tectona grandis</u>	4.2	12.4	35.1	64.5	99.4	-
<u>Boswellia serrata</u>	9.8	12.2	18.0	27.0	37.8	49.4
Rest of species	3.2	7.6	14.5	27.4	53.4	86.7

It may be seen from this table that percentage of hollow trees is generally higher in higher diameter classes. Teak and Dhawra develop hollowness at a very early stage e.g. in case of Teak almost cent-percent trees become hollow beyond 40 cm. diameter and even in lower diameter classes i.e. 20-30 and 30-40 cm. hollowness percentage is very high. It would, thus appear that it may not be advisable to grow Dhawra and Teak beyond 20 cm. diameter although Salar and Godal may possibly be allowed to grow upto 50 cm. diameter.

18. NO. OF TREES PER HA. AND TOTAL TREES IN DIVISION

No. of stems per ha. by diameter classes has been calculated for some important species occurring in the Division. No. of stem/ha. and also total stems of these species are given in Table Nos. 5 & 6.

It may be observed from these tables that tree density i.e. number of stems/ha. is fairly high but 76.8% trees are below 15 cm. diameter and only 1.2% stems are above 40 cm. diameter. Preponderance of higher diameter classes trees is maximum for salar followed by godal. In case of teak, dhawra and khirmi only 4% of trees are above 20 cm. diameter. For Khair this percentage is only 2%.

19. VOLUME/HA. AND TOTAL VOLUME

Volume has been calculated separately for Teak, Dhawra, Godal and Salar only. For rest of the species a common equation has been derived and hence combined volume of these species has been calculated. The volume/ha. of different species by diameter classes as well as total volume in the entire division is given in Table Nos. 7 & 8.

It may be seen from these tables that stocking is generally very poor. The average stocking in the division is only 26.012 m³/ha. It is interesting to note that salar and godal which are comparatively less important from utility point of view account for about 46% of the growing stock. Dhawra and teak which are most important from commercial angle account for only 15.5% of the growing stock.

Table No. 5
Stem per hectare in by Species and diameter classes (all ranges)

Species	Diameter class in Cm.								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	0.277	0.274	0.222	0.081	0.071	0.037	0.043	0.074	1.079	0.3
<i>Moegissus latifolia</i>	43.992	12.889	3.710	1.526	0.715	0.153	0.058	0.073	62.916	19.7
<i>Moegissus pendula</i>	0.995	0.360	0.202	0.092	0.080	0.005	-	-	1.734	0.6
<i>Lannea coromandelica</i>	8.597	7.802	5.407	4.339	2.673	1.593	0.769	0.463	31.643	9.9
<i>Mimosa cordifolia</i>	0.476	0.309	0.176	0.136	0.064	0.076	0.133	0.182	1.557	0.5
<i>Acacia catechu</i>	4.701	1.104	0.142	0.067	0.027	0.014	-	-	0.055	1.9
<i>Wrightia tinctoria</i>	17.611	5.849	1.901	0.918	0.199	0.036	0.303	-	26.544	8.3
<i>Terminalia tomentosa</i>	1.228	0.905	0.382	0.178	0.113	0.044	-	0.070	2.920	0.9
<i>Tectona grandis</i>	21.313	8.206	2.900	0.886	0.333	0.144	0.040	0.026	35.848	11.2
<i>Roswellia serrata</i>	3.662	4.364	4.053	3.973	3.842	2.392	1.493	1.744	25.523	8.0
<i>Diospyros melanoxylon</i>	15.437	5.385	2.057	0.767	0.308	0.148	0.026	0.014	24.112	7.6
<i>Milusa tomentosa</i>	3.795	1.312	0.416	0.171	0.038	0.058	0.025	0.038	5.853	1.8
Rest of species	51.215	21.448	10.193	5.246	2.609	1.311	0.587	1.049	93.658	29.3
Total	175.299	70.007	31.761	18.350	11.072	6.011	3.204	3.733	319.437	
Percentage	54.9	21.9	9.9	5.7	3.5	1.9	1.0	1.3	100.0	

Table No. 6

Distribution of stems (in 1000) by species and diameter classes

Species	Diameter class in cm.								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<u>Terminalia belerica</u>	126,042	124,862	101,182	37,068	32,318	17,093	19,595	33,845	492,005	0.3
<u>Mogeissus latifolia</u>	20009,713	5771,353	1687,616	694,279	325,248	69,754	26,677	33,425	28618,365	19.7
<u>Mogeissus pendula</u>	452,577	163,635	51,832	41,926	36,592	2,552	-	-	789,114	0.6
<u>Lapnea coronandolica</u>	3910,307	3548,839	2459,293	1973,545	1215,810	724,902	349,891	210,496	14393,083	9.9
<u>Adina cordifolia</u>	216,274	140,767	79,942	61,754	28,905	34,354	62,631	82,650	707,277	0.5
<u>Acacia catechu</u>	2138,192	502,281	64,821	30,825	12,491	6,388	-	-	2754,798	1.9
<u>Wrightia tinctoria</u>	8010,475	2665,706	864,844	417,423	90,399	16,400	13,579	-	12078,826	8.3
<u>Terminalia tomentosa</u>	558,553	411,698	173,776	80,799	51,585	19,894	-	31,689	1327,994	0.9
<u>Tectona grandis</u>	10603,977	3732,349	1319,328	403,061	151,326	65,212	18,110	12,071	16305,434	11.2
<u>Boswellia serrata</u>	1665,789	1985,027	1843,706	1807,092	1747,278	1088,064	679,240	793,208	11609,404	8.0
<u>Diospyros melanoxylon</u>	7021,383	2449,179	935,676	335,236	139,912	67,256	11,930	6,368	10966,960	7.6
<u>Milusa tomentosa</u>	1726,188	596,919	189,641	78,055	17,469	26,413	11,365	17,374	2683,424	1.8
Rest of species	23295,144	9755,349	4636,519	2386,261	1187,068	596,575	267,237	477,277	42601,430	29.3
Total	79734,614	31848,364	14448,176	8347,124	5036,401	2734,857	1460,255	1698,423	145301,114	
Percentage	54.9	21.9	9.9	5.7	3.5	1.9	1.0	1.2		

Table No. 7

Volume (m³) per hectare by species and diameter classes (Maipur Division)

Species	Diameter class (D.B.) in cm.								
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	Total %
<u>Anogeissus latifolia</u>	0.747	0.758	0.465	0.325	0.233	0.066	0.038	0.007	2.694 10.4
<u>Lannea coromandelica</u>	0.077	0.504	0.522	0.838	0.855	0.778	0.524	0.553	4.451 17.1
<u>Tectona grandis</u>	0.303	0.363	0.275	0.162	0.091	0.065	0.026	0.027	1.332 5.1
<u>Boswellia serrata</u>	0.047	0.145	0.399	0.802	1.316	1.235	1.081	2.407	7.432 28.6
Rest	1.244	1.740	1.578	1.217	0.936	0.704	0.453	2.401	10.103 38.8
Total	2.418	3.330	3.039	3.344	3.431	2.848	2.152	5.450	26.012
Percentage	9.3	12.6	11.7	12.8	13.2	10.9	8.3	21.0	100.0

Table No. 8

Total volume (000 m³) by Diameter & Species

Species	Diameter class (O.B.) in cm.								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<u>Anogeissus latifolia</u>	340.011	344.626	211.360	147.744	105.841	30.041	17.404	28.060	1225.087	10.4
<u>Lannea coromandeliana</u>	35.118	138.319	237.609	381.028	389.013	253.658	178.273	229.233	1942.251	17.1
<u>Tectona grandis</u>	137.802	174.155	125.058	73.826	41.596	29.819	11.796	12.392	606.835	5.1
<u>Boswellia serrata</u>	21.585	65.857	181.631	364.683	598.244	561.578	491.849	1034.842	3380.319	28.6
Rest	565.973	721.376	626.984	553.409	425.853	320.213	229.763	1092.272	4595.748	38.8
Total	1100.469	1514.333	1382.598	1520.490	1560.547	1295.314	919.085	2458.789	11749.640	
Percentage	9.3	12.8	11.7	12.8	13.2	10.9	8.3	21.0	100.0	

20. GROWING STOCK OF BAMBOO

The number of clumps/ha., number of culms/clump by age, size, condition etc. are given below :-

Table No. 9

Bamboo clumps/ha. by quality and size class in the whole division

Quality	Size class I	Size class II	Size class III	Total
I	95.36	57.79	21.21	174.36
II	26.85	12.46	4.73	44.04

Table No. 10

Average number of sound, damaged and dry-rotten culms per clump by quality and size classes.

Quality	Size class	Sound S	Damaged D	Dry-rotten DR	Total
I	1	4.88	3.24	3.52	11.64
	2	9.98	4.72	7.50	22.20
	3	15.46	7.29	11.06	33.81
II	1	3.34	5.60	6.49	15.43
	2	6.45	7.95	8.51	22.91
	3	7.31	4.94	6.13	18.38

Table No. 11

Average Number of one season, two season and three season old culms per clump by quality and size classes.

Quality	Size class	One season	Two season	Three season and more season	Total
I	1	1.35	2.89	7.40	11.64
	2	2.60	4.59	15.01	22.20
	3	4.29	5.50	24.02	33.81
II	1	1.24	3.71	10.48	15.43
	2	1.76	5.15	16.00	22.91
	3	2.25	1.69	14.44	18.38

Table No. 12

Total number of clumps by quality and size classes

Quality	Size classes			Total
	Size I	Size 2	Size 3	
I	7788567	4719743	1732358	14240668
II	1568762	728079	276212	2573053
Total	9357329	5447822	2008570	16813721

Presuming that 4 damaged or dry-rotten culms are equal to one sound culm, the total growing stock of the division has been calculated and is given below :-

Table No. 13

Total growing stock of bamboo (in 1000 standard bamboos)
Standard Bamboo = 4.572 m (15')

Quality	Clump size class			Total
	Size I	Size 2	Size 3	
I	26861	39158	22940	88959
II	3733	3415	1436	8594
Total	30594	42573	24376	97543

It may be observed from these tables that the clumps are generally very congested and the number of new recruits is very low. On an average, there are only 2.24 new recruits per clump which makes only about 10% of the total culms per clump as against requirement of 20% under normal conditions. The proportion of damaged and dry-rotten culms is very high. On an average 62% of the total culms per clump are damaged and/or dry rotten.

21. MARKET & DEMAND STUDIES

Consumption of wood & bamboo per household for different purposes is given below :-

Table No. 14

Description of the item.	Particulars of rural area			Particulars of Urban area
	For Villages within 5 kms of forest boundary.	For villages beyond 5 kms of forest boundary.	Mean	
1. Total No. of houses	169	119	-	57
2. Total No. studied of persons	994	759	-	419
3. Average plinth area per household.	70.58 sq.mt.	47.74 sq.mt.	61.14 sq.mt.	66.62 sq.mt.
4. Consumption of timber (w.r.c. per household for construction of houses.	3.098 m ³	1.541 m ³	2.455 m ³	1.687 m ³
5. Consumption of bamboo (Nos. of standard bamboos) per household for building construction.	204	204	204	10.5
6. Annual consumption of firewood per household. ✓	3.939 (tonnes)	3.210 (tonnes)	3.638 (tonnes)	1.205 (tonnes)
7. Average consumption of wood (w.r.e.) per household for agricultural implements.	0.166 m ³	0.186 m ³	0.174 m ³	-
8. Average number of agricultural implements (plough) per household	0.964	0.924	0.947	-
9. Average consumption of wood (w.r.e.) per household for bullock-carts.	0.028 m ³	0.196 m ³	0.097 m ³	-
10. Average number of bullock carts per household.	0.041	0.286	0.142	-
11. Average consumption of wood (w.r.e.) per household for persian wheel.	0.319 m ³	0.093 m ³	0.286 m ³	-
12. Average number of persian wheels per household.	0.178	0.269	0.215	-

Presently timber harvesting operations and disposals are done by the State Agency without involving Contractors agency. The average annual supplies to different industries and Government departments are given below :-

- | | |
|---|---|
| 1) M/s Gujrat Paper Mill,
Ahmedabad. | a) Bamboo waste 66 tonnes
(17.1 tonnes) |
| | b) Salar-Godal waste 250 tonnes
(102.6 tonnes) |
| 2) M/s D.C.M. Kota | Charcoal - 2110.7 tonnes
(1101.7 tonnes) |
| 3) M/s By making
Industry. | Khirni wood - 1075.5 tonnes
(979.6 tonnes) |

(figures in brackets give the annual average from 1972-73 to 1975-76).

Supplies made to various Government Departments are given in Table No. 15.

Table No. 15

Name of Deptt.	Small timber	Firewood tonnes.	Charcoal tonnes.	Bamboo (No. of standard bamboos).
1. F.W.D. including C.P.W.D.	299.60 (156.80)	2994.0 (1288.8)	- (5.00)	1500
2. Schools and colleges.	-	85.0 (28.2)	0.04 (4.21)	-
3. Irrigation	- (225.50)	-	-	-
4. Health	-	29.4 (174.8)	9.8 (4.6)	-
5. Others	-	(485.9 (222.1)	0.62 (0.21)	-
Total	299.60 (382.30)	3594.3 (1713.9)	10.46 (14.02)	1500 (375)

The supplies to industries and different Government Departments are not even 1% of the requirement of wood for local consumption and, therefore, for estimating the present as well as future requirement of wood consumption/requirement for industrial and Government Departments is not taken into consideration. The abstract of estimated requirement of wood and bamboo in different years is given below :-

Table No. 16

Particulars of consumption	1976	1980	1985
1. Wood for house construction and repairs (w.r.e.)	32032 m ³	34893 m ³	38883 m ³
2. Wood for agricultural implements (including bullock-carts & persian wheels and repairs) (w.r.e.)	56473 m ³	60200 m ³	63250 m ³
3. Firewood (w.r.e.)	1,914,766 m ³	2058373	2173259 m ³
Total :	2,003,271 m ³	2153466 m ³	2275392 m ³
4. Bamboo for house and cattle shed construction & repairs.	5,197,000 nos.	5,586,200 nos.	5,897,500 nos.

22. YIELD (ANNUAL CUT)

The annual cut depends upon growing stock, rotation, rate of growth, management practices and many other important considerations. For precise estimate of annual yield, a detailed and comprehensive information of crop, its composition, age, density, soil, topography etc. for each management unit i.e. block/compartments is necessary which is beyond the scope of this study. Therefore, the estimate of annual cut given in the following paragraphs is indicative only.

At present almost all the forests except small area under steep slopes are worked under "Coppice with standards" system with 20 years conversion period for Teak forests and 40 years for others. Salar-Godol are, however, worked under selection system with 10 years felling cycle. The exploitation diameter is 30 cms. Under the present conditions the coppice with standards system does not suit to the forests due to following reasons:-

1. The forests are extremely irregular in composition, density and growth and a few standards left do not afford sufficient protection to soil.
2. Except a few standards, all the trees are felled resulting into very heavy sacrifice of immature crop.
3. Adequate number of standards of commercial important species are not available. For example, there are only 6 stans per ha. of teak above 20 cm. as against the requirement of 40-50 stans/ha.
4. The standards are prone to illicit felling.
5. Even if the standards are properly protected they will develop hollowness by the time they become due for felling in second rotation.

In order to ensure conservation of forests and eventually obtaining full value of increment a modified system called "Coppice with reserves" may be more suitable. Under this system all well developed immature poles of valuable species should be retained as reserves after removing less valuable or other trees interfering with their growth. Besides these, well grown trees and poles of fruit bearing species can also be retained. A perusal of Table No. 3 will show that natural regeneration is almost absent. Lack of sufficient moisture and excessive biotic interference are perhaps the most important factors responsible for this state of affairs. Further, Teak (Tectona grandis), Dhawra (Acagissus latifolia) develop hollowness at very early age (more than 50% of the trees become hollow beyond 20 cm.) Maybe that the site may not support bigger size crop but it is a common experience that successive coppicing encourages hollowness at an early age. Therefore, serious efforts should be made to supplement the coppice crop with artificial regeneration. Effective closure of the coupe and appropriate soil conservation practices like contour trenching, checking damming etc. two years in advance of felling is likely to be very beneficial and may encourage natural regeneration. This will also help in establishing the artificial regeneration to be done immediately after the felling.

Under the recommended silvicultural system i.e. "Coppice with reserves system" the annual yield will naturally depend upon the extent of reservation. It will be seen from Table No. 8 that approximately 25% of the growing stock of teak and Dhawra is under 10 cm. diameter and another 30% is in 10-15 cm. diameter class. On the other hand in case of Salar and Godal only 5% of the growing stock is under 15 cm. diameter while for miscellaneous species 30% of the growing stock is below 15 cm. Keeping in view these variations in the proportion of the growing stock in pole stage, it is presumed that 30% of the growing stock of Teak and Dhawra, 5% of Salar and Godal and 20% of rest of species may have to be retained as reserves. Basing on these assumptions and with a conversion period of 40 years, the estimated annual yield would be as given below :-

1. Teak	=	$606235 \times \frac{70}{100} \times \frac{1}{40} = 10609 \text{ m}^3$
2. Dhawra	=	$1225087 \times \frac{70}{100} \times \frac{1}{40} = 21439 \text{ m}^3$
3. Salar	=	$3380319 \times \frac{95}{100} \times \frac{1}{40} = 80283 \text{ m}^3$
4. Godal	=	$1942251 \times \frac{95}{100} \times \frac{1}{40} = 46128 \text{ m}^3$
5. Rest of species	=	$4595748 \times \frac{80}{100} \times \frac{1}{40} = 91915 \text{ m}^3$

Total Yield = 250374 m³

23. BAMBOO

The proportion of dead & dry culms is very high. They should be removed as early as possible so as to improve hygienic conditions of crop. No yield is expected from clumps, which are having less than 8 sound culms/clump of more than one year old. Keeping in view the distribution of culms by age, condition etc. and presuming that all the dead, dry and half cut culms will be removed in a felling cycle of 4 years, following yield is expected.

1. Dry bamboo - 6.21 million standard bamboo
or 12,400 m.t.

2. Green bamboo - 8.2 million standard bamboo
or 16,400 m.t.

It may be noted that total annual recruitment is about 34 million culms which is equal to 20 million standard bamboo or 40,000 m.t. Under normal conditions the annual yield should be equal to annual recruitment. Thus the annual yield under normal conditions should have been about 40,000 M.T. But the conditions are far from normal. About 60% of the clumps contain less than 8 sound culms per clump required for retention. Therefore, a considerably low yield of green culms is suggested so as to build up the growing stock to required level. After first cutting cycle the yield of dry bamboo will fall to negligible amount. But in the mean time, the growing stock of green bamboo will increase and consequently the yield of green bamboo will increase substantially. In fact, if all the dead, dry, damaged and half cut culms are removed in first cycle, the annual recruitment will increase considerably and the yield may exceed 40,000 M.T. during second cutting cycle. It will not be out of place to mention that the survey area has a great potential for bamboo and if properly protected and managed scientifically, the annual yield may even exceed 50,000 M.T.

Udaipur

24. INDUSTRIAL SURPLUS

In order to ensure sustained supply of raw material for wood-based industries, it is necessary to estimate the present level of wood consumption by local population and the existing wood based industries and to make realistic projections of future demand. The quantity of material required by local population and the existing industries should be set apart while planning for expansion of industrial activity. Table No. 17 gives the present and projected demand of the different wood by local people and the potential annual cut which gives idea of availability of raw material for wood based industries.

Table No. 17

Estimated surplus wood & bamboos in different years

Year	Potential annual cut		Requirement for domestic purposes		Surplus available	
	timber (000 m ³)	bamboo (000 tonnes)	Timber (000 m ³)	Bamboos (000 tonnes)	Timber (000 m ³)	Bamboos (000 tonnes)
1976	250.374	28.800	2003.271	10.394	(-)1752.897	18.406
1980	250.374	28.800	2153.466	11.172	(-)1903.092	17.628
1985	250.374	28.800	2275.392	11.795	(-)2025.018	17.005

It would be clear from above table that except for a small quantity of bamboos, there is nothing available as surplus for industrial purposes. However, during consumption survey, it has been found that though there is acute shortage of timber supply in the area, yet Salar and Godel which account for approximately 45% of the total growing stock and extent for domestic purposes. Therefore, the total yield of these species can be considered as surplus to local requirement. Thus following quantity of wood and bamboos can find use in industry.

50% of the potential yield, are not used to any appreciable	<u>Salar</u>	- 80,000 m ³ out of which about 46,000 m ³ will be above 10 cm. diameter (O.B.)
	<u>Godel</u>	- 46,000 m ³ out of which about 19800 m ³ will be above 20 cm. diameter (O.B.)
	Bamboos	- 17,000 M.T.

P R E F A C E

On request from Rajasthan Forest Department, the Preinvestment Survey of Forest Resources Organisation took up forest resources survey work in Udaipur Forest Division through its Northern Zone. Initially, the field work was planned and started for estimating the total growing stock irrespective of ownership in December, 1975. Later on, during the course of survey, Forest Department revised the objectives of survey which necessitated the modification of inventory design. Unfortunately, for want of basic area information from Rajasthan Forest Department, the field work had to be stopped in March, 1976. Subsequently, when the relevant information was made available, the field work was again started in December, 1976 and was completed by May, 1977. In addition to our work, data of Sirohi and Chittorgarh divisions, (collected by the Resources Survey Division of Rajasthan Forest Department) was processed by us with the help of electronic computer and the resultant tables were supplied to the Rajasthan Forest Department during 1976.

The main objectives of the survey, as decided in consultation with Rajasthan Forest Department, were to estimate total growing stock of the Forests of the division by ranges and working circles and also the growing stock of forests outside the control of Forest Department, within certain precision limits. Other objectives included estimation of demand of timber and bamboos in order to find out the raw materials likely to be available for industrial purposes.

The total growing stock for the division as well as for the ranges has been estimated separately within desired precision. The growing stock for different working circles and also that of forests outside the control of Forest Department, however, could not be estimated for want of corrected management map of the division. The working plan of Udaipur Forest Division was under revision and quite a few changes in allotment of blocks/ compartments to working circles were expected. The corrected management map of Udaipur Forest Division could not be available even upto March, 1978 and this report, therefore, has been compiled on the basis of old management map, which had been updated by Working Plan Officer, Udaipur by including in it some more areas surveyed by him.

The total growing stock and also potential annual cut of a few important species viz. Tectona grandis, Boswellia serrata, Noceissus latifolia, and Lannea coromandelica has been estimated separately. The present and future demand of timber and bamboos has also been estimated. From inventory results, it is established that except for a small quantity of Boswellia serrata, Lannea coromandelica and bamboos, there is nothing else which can be available for industrial purposes. As a matter of fact, the total annual potential cut of all species is not enough to meet even the present demand of local population. Since Boswellia serrata and Lannea coromandelica presently are not locally used for any purpose to any appreciable extent, the potential annual cut of these species can be considered as available for industrial purposes.

The inventory results have shown that about 80,000 m³ or salar (Boswellia serrata) and 40,000 m³ of godal (Lannea coromandelica) wood can be available annually for industrial use. In addition, about 17000 M.T. bamboo is annually surplus to local requirement. Salar is quite suitable for match splints and godal is considered to be class I timber for plywood. Therefore about 15,000 m³ (above 20 cm. d.o.b.) godal and 40,000 m³ (above 10 cm. d.o.b.) salar wood can be used annually for making plywood and match splints, respectively. The balance quantity (app. 70,000 m³) of salar and godal wood and about 17000 M.T. bamboos can be supplied to pulp and paper mills. This quantity of wood and bamboos, is not sufficient to feed a new pulp and paper mill, but a considerable quantity of bamboos and salar - godal wood may be available from nearby divisions and therefore, possibility of establishing a pulp and paper mill in the survey area may be explored.

The cooperation and assistance provided by the officers and staff of Rajasthan Forest Department is gratefully acknowledged. It has to be mentioned specifically that without their cooperation this work could not be done.

The Preinvestment Survey of Forest Resources acknowledges the hard work put in by members of the Northern Zone including S/Shri D.D. Mehta, A.P. Dwivedi, Parmatan Singh and V.P. Singh. Shri R.D. Gupta had detailed discussions with the Rajasthan Forest Department before compiling the final recommendations.

(C.L. Bhatia)
Chief Coordinator.

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List of Abbreviations

app.	=	Appendix
Av.	=	Average
°C	=	Degree centigrade
C.D.	=	Card Design
cm.	=	Centimeter
D.B.H.	=	Diameter at Breast Height
D.B.H.O.B.	=	Diameter at Breast Height Over Bark
D.P.U.	=	Data Processing Unit
E	=	East
ha.	=	Hectare
I.S.I.	=	Indian Standards Institution
Kgs.	=	Kilograms
Km.	=	Kilometer
Cu.m. or m ³	=	Cubic meter
mt.	=	Meter
M.T.	=	Metric tonne
N	=	North
N-S	=	North South
N-W	=	North West
O.B.	=	Over Bark
P.I. Section	=	Photo-interpretation Section
QI	=	Quality I
QII	=	Quality II
S	=	South
S.E.	=	Standard Error
Sq.	=	Square
Sq.km. or km ²	=	Square kilometer
S-W	=	South West
S-1	=	Size 1
S-2	=	Size 2
S-3	=	Size 3
Vol.	=	Volume
W.P.O.	=	Working Plan Officer
w.f.e.	=	Wood round equivalent
Sp.	=	Species

Conversion Factors Used

Length of standard bamboo	= 4.572 m. (15')
1 tonne (Bamboo)	= 500 standard bamboos
1 tonne (Timber)	= 1.5 m ³
1 m ³ Sawn wood	= 2 m ³ round wood.
1 tonne of Charcoal	= 4 tonnes of fuel wood (solid)

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Local name of species appearing in the report

<u>Local name</u>	<u>Botanical name</u>
Behera, Beda	<i>Terminalia belerica</i>
Dhawra	<i>Anogeissus latifolia</i>
Dhokra, Kantya, Kaldi	<i>Anogeissus pendula</i> 15.
Godal	<i>Lannea coromandelica</i>
Haldu	<i>Adina cordifolia</i>
Khair	<i>Acacia catechu</i>
Khirmi, Dudhi	<i>Wrightia tinctoria</i>
Sodar	<i>Terminalia tomentosa</i>
Sag : Sagwan	<i>Tectona grandis</i>
Salar, Halar	<i>Boswellia serrata</i>
Timru	<i>Diospyros melanoxylon</i>
Umbia	<i>Miliusa tomentosa</i>

SUMMARY AND RECOMMENDATIONS

1. GENERAL

Most of the forest resources of Rajasthan are concentrated in Southern part of the State consisting of Udaipur, Chittorgarh, Sirohi, Banswara and Dungarpur districts. Resources Survey Division of Rajasthan Forest Department started survey of these forests. However, the Resources Survey Division was wound up during 1973-74 without completing survey in Udaipur Division. Consequently, on request from Rajasthan Forest Department, the survey work in Udaipur Forest Division was undertaken by Northern Zone of Preinvestment Survey of Forest Resources Organisation.

2. OBJECTIVES

The main objectives of the survey were -

- i) to estimate the growing stock of timber in the forests under the control of Forest Department within $\pm 10\%$ error for the division and within $\pm 20\%$ error for ranges/working circles at 95% probability level;
- ii) to estimate the growing stock of bamboo in the division;
- iii) to estimate the extent of poorly stocked but potentially productive forests under the control of Forest Department;
- iv) to estimate the growing stock of forests of division outside the control of Forest Department;
- v) to estimate the present and future demand of wood and bamboo in the area and calculate the surplus, if any, for industrial purposes.

3. SAMPLING DESIGN

Fixed plot method with square plot of 0.16 ha. area was adopted for inventory of growing stock. The plots were distributed systematically all over the area with variable sampling intensity from range to range. For details of sampling design and methodology, Volume II of this Report may be referred to.

4. AREA SURVEYED

The survey area comprises Udaipur Forest Division i.e. Udaipur district except Bhim tehsil. The geographical area is 15,200 km². The forest area determined by planimetry of the old management maps and updated recently by Working Plan Officer of Udaipur Division works out to 4548.45 km². There is, however, a wide discrepancy in the forest area reported by different agencies. For example, Rajasthan Forest Department reported the forest area of the division to be 10,135 km² as against 1123.75 km² reported by 1971 census and 4198.26 km² covered by working plan in force. This report is based on the forest area (4548.45 km²) determined from the updated management maps.

5. AREA UNDER DIFFERENT FOREST TYPES

Six forest types namely, Teak, Dhok, Salar-Godal, Mixed Misc. with Teak, Mixed Misc. without Teak and others were recognised for the purpose of this survey; and area under these types works out to 7.82%, 0.39%, 45.31%, 11.1%, 31.61% and 3.77% of total forest area respectively. Teak forests are mainly confined to Bansi, Dhariawad and Salumber ranges and Dhok forests to Udaipur and Kurabar ranges. All the other forest types occur in almost all the ranges but to a varied extent. The percentage area under Salar-Godal type in Udaipur, Salumber, Kurabar, Parsad, Kotra and Kumbalgarh ranges is higher than the average for the division.

6. AREA UNDER BIOTIC INTERFERENCE

Four categories of biotic interference namely very heavy, heavy, moderate and light, were recognised and the area under these categories is 14.78%, 26.21%, 47.08% and 11.93% of total forest area respectively. The biotic interference in Udaipur, Parsad, Salumber and Kurabar ranges is higher than the remaining ranges (Appendix; Table - 2).

7. AREA UNDER NATURAL REGENERATION

The area under different categories of natural regeneration viz. Profuse, Adequate, Scanty and Nil is 1.19%, 7.01%, 41.11% and 50.69% of total forest area respectively. The natural regeneration is either scanty or absent over 91.80% of the total area and thus, the position is far from satisfactory. The natural regeneration is Salumber, Kurabar, Bansi and Gogunda ranges is almost absent.

8. POORLY STOCKED BUT POTENTIALLY PRODUCTIVE FOREST AREA

The areas where crown density is less than 0.4 but nature of vegetative cover and soil conditions, indicate that the site can support much better forests than the existing ones, have been identified and are called "poorly stocked but potentially productive" forests. The total area under such forests is 1481.648 km² i.e. 32.56% of the total forest area. The area of poorly stocked but potentially productive forests in Udaipur, Parsad, Kurabar and Gogunda ranges is 55.68%, 58.03%, 47.20% and 52.63% of forest area respectively, which is much higher than other ranges.

9. VOLUME TABLES

652 trees (*A. latifolia*, 107; *L. coromandelica*, 97; *T. grandis*, 120; *B. serrata*, 86; and misc. species, 242) were felled for preparation of volume tables. The volume equations derived which will be applicable to trees of 10 cm. D.B.H. (O.B) and above are given below :-

<u>Species</u>	<u>Equation</u>
<u>T. grandis</u> (Teak)	$V = 0.062108 - 0.927983 D + 6.613031 D^2$
<u>B. serrata</u> (Salar)	$V = -0.155316 + 2.714875 D$
<u>L. coromandelica</u> (Godal)	$V = -0.046731 - 0.962906 D + 7.301883 D^2$
<u>A. latifolia</u> (Dhawra)	$V = -0.004378 + 4.575823 D^2$
Rest of species	$V = 0.081467 - 1.063661 D + 6.452918 D^2$

Where -

V = Under bark tree volume (m^3) upto a limit of 5 cm. over bark diameter;

D = Over bark diameter (m) at breast height.

10. BARK VOLUME

The bark percentage decreases in all the species as the diameter increases. In decreasing order of bark percentage, the order of important species is Lannea coromandelica, Boswellia serrata, Tectona grandis and Anogeissus latifolia.

11. CULL/HOLLOWNESS

The data on cull were collected from felled trees and the percentage of hollow trees by diameter classes has been determined for important species. For all the species except Lannea coromandelica, hollowness starts even in 5-10 cm. diameter class trees. In case of Lannea coromandelica hollowness starts in 20-30 cm. diameter class trees. Percentage of hollow trees increases in all the species as the diameter increases. The important species arranged in descending order of hollowness are T. grandis, A. latifolia, B. serrata and L. coromandelica and percentage of hollow trees in 40-50 cm. diameter class for these species is 99.4, 81.9, 37.8 and 7.4 respectively.

12. STEMS PER HECTARE

The stems per ha. varies a great deal from 152.475 in Parsad range to 526.368 in Panarwa range with an average figure of 319.442 stems per ha. for the division. The trees, however, are of small sizes; 73.87% of the stems are below 15 cm. diameter and only 1.2% are above 40 cm. diameter. The distribution of stems in different diameter classes is not uniform for all the species. Preponderance of higher diameter classes is more in case of Boswellia serrata and Lannea coromandelica as compared to other species. The stems above 20 cm. and 40 cm. D.B.H. (O.B.) in respect of Terminalia belerica, Anogeissus latifolia, Anogeissus pendula, Lannea coromandelica, Mine cordifolia, Zamia catechu, Wrightia tinctoria, Terminalia tomentosa, Tectona grandis, Boswellia serrata, Diospyros melanoxylon and Millusa tomentosa are respectively 28.34, 4.01, 10.21, 31.09, 37.96, 1.78, 4.46, 13.87, 3.97, 52.67, 5.11, 5.64 and 6.86, 0.12, 0.00, 1.46, 11.69, 0.00, 0.00, 2.39, 0.07, 6.03, 0.06, 0.065 percent of total stems of respectively species.

13. GROWING STOCK

The volume per ha. and the total volume has been calculated separately for Tectona grandis, Shorea latifolia, Lannea coromandelica; and Boswellia serrata only. All other species have been grouped together. The volume/ha. and the total volume in the division as well as ranges is given below :-

Table No. 1

Volume (m³) per hectare by species & diameter classes
(Udaipur Division)

Diameter in cm. (D.B.H.O.B.)	Species					Total	Per- cent- age.
	<u>Shorea</u> <u>latifolia</u>	<u>Lannea</u> <u>coromandelica</u>	<u>Tectona</u> <u>grandis</u>	<u>Boswel-</u> <u>lia</u> <u>serrata</u>	Rest all other species		
5-10	0.747	0.077	0.303	0.047	1.244	2.418	9.3
10-15	0.758	0.304	0.383	0.145	1.740	3.330	12.8
15-20	0.465	0.522	0.275	0.399	1.378	3.039	11.7
20-25	0.325	0.838	0.162	0.802	1.217	3.344	12.8
25-30	0.233	0.855	0.091	1.316	0.936	3.431	13.2
30-35	0.066	0.778	0.065	1.235	0.704	2.848	10.9
35-40	0.038	0.524	0.026	1.081	0.483	2.152	8.3
40+	0.062	0.553	0.027	2.407	2.401	5.450	21.0
Total	2.694	4.451	1.332	7.432	10.104	26.012	
Percentage	10.4	17.1	5.1	28.6	38.8		

Table No. 2
Volume/ha. (m³) by Ranges & Species

Name of Range	<u>Mogei-ssus latifolia</u>	<u>Lannea coroe-mandelicola</u>	<u>Tectona grandis</u>	<u>Boswellia serrata</u>	Rest of spp.	Total of all spp.	Standard error %
1	2	3	4	5	6	7	8
Udaipur	1.048	2.586	-	6.269	4.445	14.348	11.32
Parsad	1.302	2.855	0.182	7.204	3.864	15.407	10.51
Salumbar	1.185	4.013	2.463	5.292	4.080	17.033	11.47
Kurebar	0.416	2.441	-	6.524	3.500	12.881	18.43
Kherwada	3.254	2.871	1.030	5.789	10.840	23.784	11.34
Gogunda	5.065	3.325	-	5.642	9.059	23.091	13.44
Bansil	1.885	5.157	4.840	5.250	8.506	25.638	9.98
Panarwa	2.673	6.059	0.462	3.516	18.442	31.152	9.06
Jhadol	3.376	2.536	0.449	4.198	12.813	23.372	13.65
Kotra	3.843	6.652	0.164	13.618	14.122	38.399	9.10
Dhariawad	3.355	6.213	6.942	5.437	7.721	29.668	8.23
Kumbalgarh	2.913	4.531	0.188	12.671	12.066	32.369	8.69
Average for the division	2.694	4.451	1.332	7.434	10.104	26.012	
Standard error (%)	6.68	6.30	8.96	8.51	5.86	3.32	

Table No. 3

Total volume (000 m³) by Diameter and species
(Udaipur Division)

Diameter in cm. D.B.H.O.B)	<u>Mogel-</u> <u>ssus</u> <u>latifo-</u> <u>lia</u>	<u>Tennea</u> <u>coroma-</u> <u>delica</u>	<u>Tectona</u> <u>grandis</u>	<u>Boswe-</u> <u>llia</u> <u>serrata</u>	Rest all other spp.	Total	%
1	2	3	4	5	6	7	8
5-10	340.001	35.118	137.802	21.585	565.973	1100.489	9.3
10-15	344.626	138.319	174.155	65.857	791.376	1514.333	12.8
15-20	211.360	237.609	125.059	181.681	626.884	1382.593	11.7
20-25	147.744	381.028	73.626	364.683	553.409	1520.490	12.8
25-30	105.841	389.013	41.596	598.244	425.853	1560.547	13.2
30-35	30.041	353.658	29.819	561.578	320.218	1295.314	10.9
35-40	17.404	173.273	11.796	491.849	219.763	919.085	8.3
40+	28.060	229.233	12.382	1094.842	1092.272	2456.789	21.0
Total	1225.087	1942.251	606.235	3380.319	4595.748	11749.640	
Percentage	10.4	17.1	5.1	28.6	38.8	100.0	

Table No. 4

Total volume (in 000 m³) by species & Ranges

Name of Range	<u>Mogei- ssus latifolia</u>	<u>Lannea coromana- ndelica</u>	<u>Tectona grandis</u>	<u>Boswellia serrata</u>	Rest of Species	Total of all species.
Udaipur	40.688	100.401	-	243.393	172.575	557.057
Parsad	50.039	109.728	6.995	276.872	148.505	592.139
Salumber	27.726	93.893	57.626	123.348	95.461	398.054
Kurabar	8.183	48.017	-	128.330	68.846	253.376
Kherwara	130.282	114.948	41.240	231.779	434.011	952.260
Gogunda	82.212	53.969	-	91.577	147.040	374.798
Bansi	47.628	130.305	122.295	132.657	214.929	647.814
Panarwa	113.707	257.746	19.652	149.568	784.508	1325.181
Jhadol	161.061	120.987	21.421	200.276	611.282	1115.027
Kotra	286.557	436.014	12.229	1015.442	1053.024	2803.266
Dhariawad	153.097	283.515	316.781	248.105	352.330	1353.828
Kumbalgarh	123.907	192.728	7.996	538.972	513.237	1376.840
Total	1225.087	1942.251	606.235	3380.319	4595.748	11749.640

It may be noted from the above tables that Boswellia serrata and Lannea coromandelica which are comparatively of low economic value account for 45.7% of the total growing stock. There is considerable variation in growing stock from range to range. The volume/ha. varies from 12.881 m³ in Kurabar range to 38.399 m³ in Kotra range with average figure of 26.012 m³/ha. for the division. Stocking in Udaipur, Parsad, Salumber and Kurabar ranges is comparatively poor and Boswellia serrata and Lannea coromandelica account for 61.7%, 65.5%, 54.7% and 69.6% of the growing stock in these ranges respectively. It may be interesting to note that 61.84%, 73.14%, 75.44% and 73.33% forest area of these ranges respectively falls under very heavy and heavy categories of biotic interference. Thus, the reasons for low stocking and higher percentage of less important species appear to be biotic rather than climatic.

14. BAMBOO RESOURCES

For estimating the growing stock of bamboos, three size classes and two quality classes were recognised and the results are summarised below:

Table No. 5

Bamboo clumps/ha. by quality and size class in the whole division
(Based on Bamboo occurring areas)

Quality	Size class I	Size class II	Size class III	Total
I	95.36	57.79	21.21	174.36
II	26.85	12.46	4.73	44.04

Table No. 6

Average Number of sound, damaged and dry-rotten culms by quality and size class

Quality	Size class	Sound S	Damaged D	Dry-rotten DR	Total
I	1	4.88	3.24	3.52	11.64
	2	9.98	4.72	7.50	22.20
	3	15.46	7.29	11.06	33.81
II	1	3.34	5.80	6.49	15.43
	2	6.45	7.95	8.51	22.91
	3	7.31	4.94	6.13	18.38

Table No. 7

Average Number of one season, two season and three season old culms per clump by quality and size class

Quality	Size class	One season	Two season	Three seasons and more seasons.	Total
I	1	1.35	2.89	7.40	11.64
	2	2.60	4.59	15.01	22.20
	3	4.29	5.50	24.02	33.81
II	1	1.24	3.71	10.48	15.43
	2	1.76	5.15	16.00	22.91
	3	2.25	1.69	14.44	18.38

It may be observed from above tables that the clumps are generally very congested and the number of new recruits is very low. On an average the number of new recruits per clump is about 10% of the total number of culms in the clump. The proportion of damaged and dry-rotten culms is very high and they account for about 62% of the total number of culms.

Presuming that four damaged or dry-rotten culms are equal to one sound culm, the total growing stock of bamboo in terms of number of standard bamboos has been estimated and same is given below.

Table No. 8

Total growing stock of bamboo (in '000 standard bamboo)

Quality	Sizes			Total
	Size-1	Size-2	Size-3	
I	26861	39158	22940	88959
II	3733	3415	1436	8584
Total	30594	42573	24376	97543

15. POTENTIAL ANNUAL CUT (YIELD) OF TIMBER

For estimating the potential annual cut the growth rate of important species and different silvicultural aspects have been taken into consideration. With a conversion period of 40 years the expected potential annual cut of important species would be as under :-

<u>Tectona grandis</u>	=	10800 m ³
<u>Nageissus latifolia</u>	=	21400 m ³
<u>Boswellia serrata</u>	=	80300 m ³
<u>Lannea coromandelica</u>	=	46100 m ³
All other species	=	92000 m ³
Total	=	250400 m ³

16. POTENTIAL ANNUAL CUT (YIELD) OF BAMBOOS

The annual yield of bamboos has been estimated with the presumption that all the damaged and dry-rotten culms will be removed in one felling cycle of four years and part of the annual recruits will also be removed every year. Taking 500 standard bamboos equal to one tonne, the annual yield of bamboos in first felling cycle works out to 28400 M.T. out of which 12400 M.T. will be dry bamboo. Removal of dead, dry, damaged and half cut culms will ensure better hygienic conditions and is likely to increase the yield of green bamboo in second cutting cycle.

17. OUT-TURN OF WOOD AND BAMBOOS

The data on out-turn from forests under the control of Forest Department, Revenue Department and Private people were collected. The average annual removal of timber, firewood, charcoal and bamboos during the period from 1972-73 to 1975-76 from all these forests were 11821.898 m³, 11451.6 tonnes, 6411.7 tonnes and 68,57,800 standard bamboos respectively.

18. EXPORT/IMPORT OF WOOD AND BAMBOOS

The survey area is deficit in timber resources and quite a substantial quantity of wood is imported. The total out-turn of bamboos, however, is not utilized locally and about 25,52,000 standard bamboos are exported out of survey area every year.

19. CONSUMPTION BY INDUSTRIES

There is hardly any wood based industry in the survey area except the toy making industry. Some supplies are made to industries outside survey area. The supplies (annual average from 1972-73 to 1975-76) to different wood industries is given below :-

- | | |
|---|-------------------------------------|
| 1. M/s Gujrat Paper Mill,
Ahmedabad. | a) Bamboo waste = 17.1 tonnes |
| | b) Salar-Godal waste = 102.6 tonnes |
| 2. M/s D.C.M. Kota | Charcoal = 1101.7 tonnes |
| 3. Toy Making Industry | Wrightia = 979.6 tonnes. |
| | tinctoria wood |

20. CONSUMPTION OF WOOD BY LOCAL POPULATION

A house sample survey of low intensity was done to estimate the wood and bamboo consumption by local people for domestic purposes. The villages were divided into two categories depending upon their distances from nearest forests. Per house-hold consumption of rural and urban people for domestic purposes is given below.

Table No. 9

Description of the item	Particulars of rural area			Particulars of urban area
	For villages within 5 kms.	For villages beyond 5 kms.	Mean	
1. Consumption of timber (w.r.e.) per household for construction of houses.	3.098 m ³	1.541 m ³	2.455 m ³	1.687 m ³
2. Consumption of bamboos (nos. of standard bamboos) per household for building construction.	204	204	204	10.5
3. Annual consumption of firewood per household.	3.939 (tonnes)	3.210 (tonnes)	3.638 (tonnes)	1.205 (tonnes)
4. Average consumption of wood (w.r.e.) per household for agricultural implements (plough)	0.166 m ³	0.186 m ³	0.174 m ³	-
5. Average consumption of wood (w.r.e.) per household for bullock-carts.	0.028 m ³	0.196 m ³	0.097 m ³	-
6. Average consumption of wood (w.r.e.) per household for persian wheel.	0.319 m ³	0.093 m ³	0.226 m ³	-

21. FORECAST OF FUTURE DEMAND AND SURPLUS

Since there is hardly any wood based industry in the survey area, the forecast of future demand has been made only for domestic consumption and same is given below :-

	<u>1976</u>	<u>1980</u>	<u>1985</u>
Requirement of timber (in million m ³)	2.003	2.153	2.275
Requirement of bamboos (000 tonnes)	10.394	11.172	11.795

The expected potential annual cut of wood is only 0.25 million m³ which is far less than the requirement for domestic purposes. However, presently local people do not use Roswellia serrata and Lannea coromandelica for any purpose to any appreciable extent and therefore, entire annual cut of these species may be taken as surplus.

Thus, the total expected annual surplus for industrial purposes will be -

<u>Roswellia serrata</u>	- 80,000 m ³ out of which about 46,000 m ³ will be above 10 cm. diameter (O.B.)
<u>Lannea coromandelica</u>	- 46,000 m ³ out of which 19,800 m ³ will be above 20 cm. diameter (O.B.)
Bamboos	- 17,000 M.T.

22. RECOMMENDATIONS

From the above discussions, it may be observed that while on one hand the survey area is deficit in conventional timber resources and special efforts are warranted to increase the resources; on the other hand, Salar and Godal are surplus to local requirement and this material must find use in industry. Keeping in view these observations, following recommendations are made :-

- i) The total forest area was reported to be 10,135 km² but only 4199 km² was covered by the previous Working Plan. The Survey Report has covered 4548 km² (i.e. all the areas covered by previous Working Plan plus a few more areas surveyed by the W.P.O. till completion of field work). Even the revised Working Plan has covered only 4779 km². Thus still a vast forest area is left un-covered by the current Working Plan and falls under the category "Un-classed "Un-surveyed" Forests. All these unclassified forests should be surveyed and brought under scientific management at the earliest. Most of these forests are already in a degraded stage and if they are not brought under scientific management immediately, site conditions will deteriorate further which will pose more problems of their management.

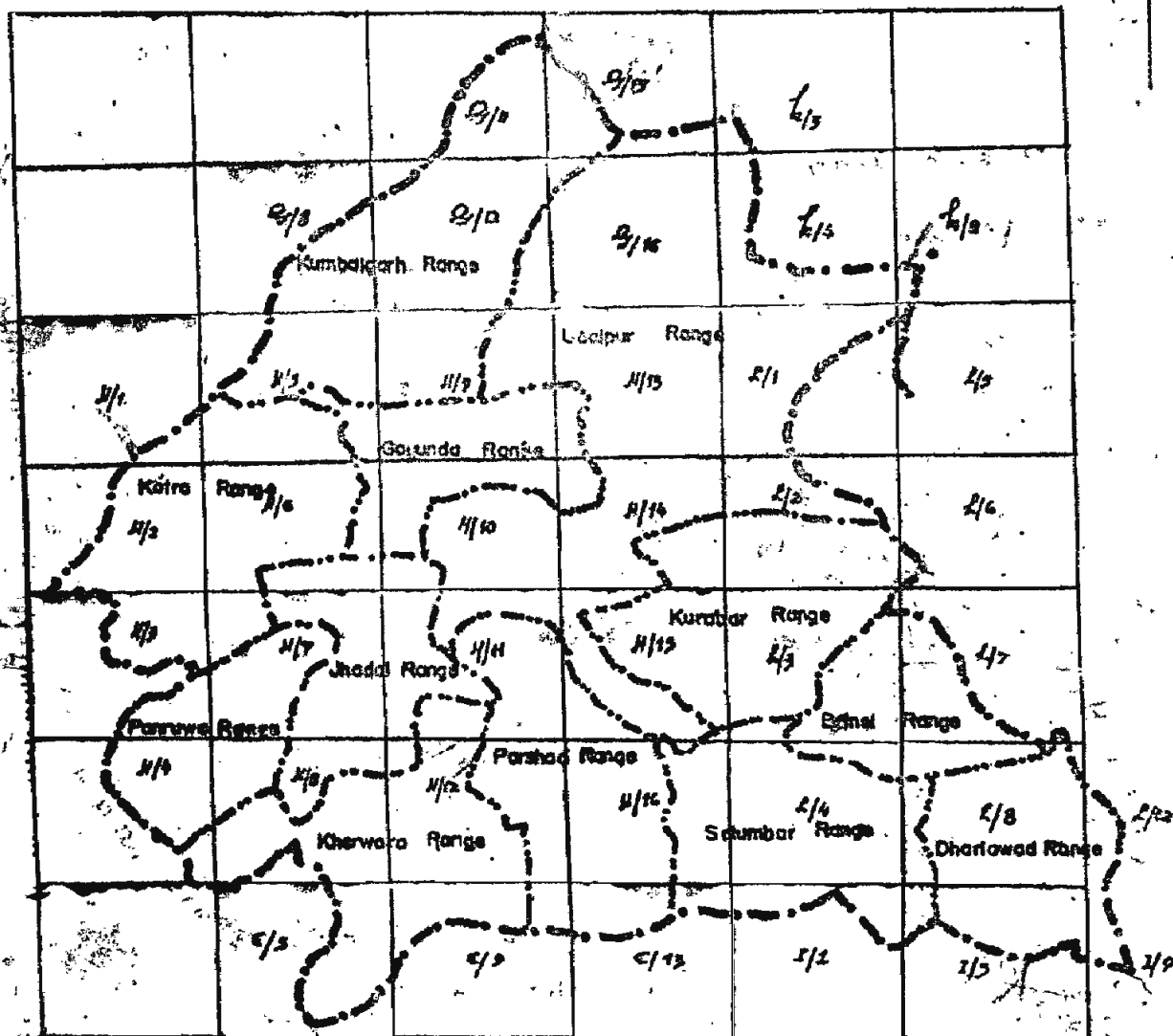
- ii) All the poorly stocked but potentially productive forests i.e. the forest areas having crown density less than 0.4 and suitable for plantation should be afforested with suitable spp. as early as possible, preferably within next 20 years. The total extent of such forests is 1,482 km².
- iii) All the unclassed and unsurveyed forests should be included in the working plan as early as possible. The extent of such forests is expected to be 3,000 km² or even more. These forests are in a degraded stage. The average growing stock in these forests is only 10.041 m³/ha. as against 26.012 m³/ha. in forests covered by Working Plan. These forests should be afforested with suitable spp. as early as possible, preferably within 20 years.
- iv) Teak and Dhawra which are the main commercial spp. develop hollowiness at a very early stage. May be that the site may not support bigger size crop, but it is a common experience that successive coppicing induces hollowiness at an early age. Natural regeneration of these spp. is almost absent over most of the area. Therefore, serious efforts should be made to supplement the coppice regeneration with artificial regeneration in normal felling coupes.
- v) It is observed that excessive biotic interference and lack of adequate moisture are the two main factors responsible for poor regeneration. In order to overcome this difficulty, it is recommended that the felling coupes/ plantation areas should be effectively closed for grazing at least 2-3 years in advance to undertaking felling/ plantation work and suitable water conservation measures such as contour trenching, bunding etc. should also be resorted to simultaneously. This will help in establishing natural regeneration as well as artificial regeneration.
- vi) The survey area is fairly rich in bamboo resources, but with the preponderance of dead, dry, damaged and half cut culms. This has resulted in too much congestion in the clumps and therefore, annual recruitment of culms is very low. In order to improve the hygienic conditions, it is recommended that all the dead, dry, damaged and half cut culms should be removed in one felling cycle even if such an operation results in some loss. This loss will be more than compensated by way of increased availability of green bamboo after first cutting cycle.
- vii) Annual yield of Salar is expected to be about 80,000 m³ out of which about 54,000 m³ will be above 10 cm. diameter (O.B.). This quantity can be used for making matches. Out of total estimated yield of 46,000 m³ of Godal about 19,800 m³ will be above 20 cm. diameter (O.B.). According to I.S.I. specifications Godal is graded as Class I timber for plywood. Therefore, this wood (i.e. about 19,800 m³) can be used for plywood. In addition, about 17,000 M.T. bamboo is surplus to local consumption. Keeping in view the above observations it is recommended that :

- (a) A Plywood Factory of about 15,000 m³ annual intake capacity and a Match Factory or a series of Cottage Industries for making matches with annual intake capacity of about 40,000 m³ may be installed in the survey area.
- (b) The market for balance quantity (about 71,000 m³) of Salar-Godol wood and 17,000 M.T. of bamboo should be explored. This material may be supplied to near by Pulp & Paper Mills or possibilities of installing a Pulp & Paper Mill in survey area may be explored. The total quantity of raw material available from survey area may not be sufficient to feed a Pulp & Paper Mill but a considerable quantity of Salar-Godol wood and bamboo is likely to be available from Chittorgarh, Dungarpur, Banswara and Sirohi divisions.

The above recommendations are based on the presumption that the regeneration will keep pace with the fellings and existing strength of staff will suitably be increased so as to control the voluminous work of fellings and afforestation efficiency. It may be noted that the annual plantation target is to the tune of 24,900 ha. In addition, about 6400 ha. has to be coppiced and the coppice regeneration is to be supplemented with artificial regeneration.

The annual yield and plantation targets are based on the total forest area which includes the area under present or proposed Wild Life Sancturries. Depending upon nature of activities permissible and the extent of area under the Wild Life Sancturries, the yield and plantation figures may be modified.

UDAIPUR FOREST DIVISION

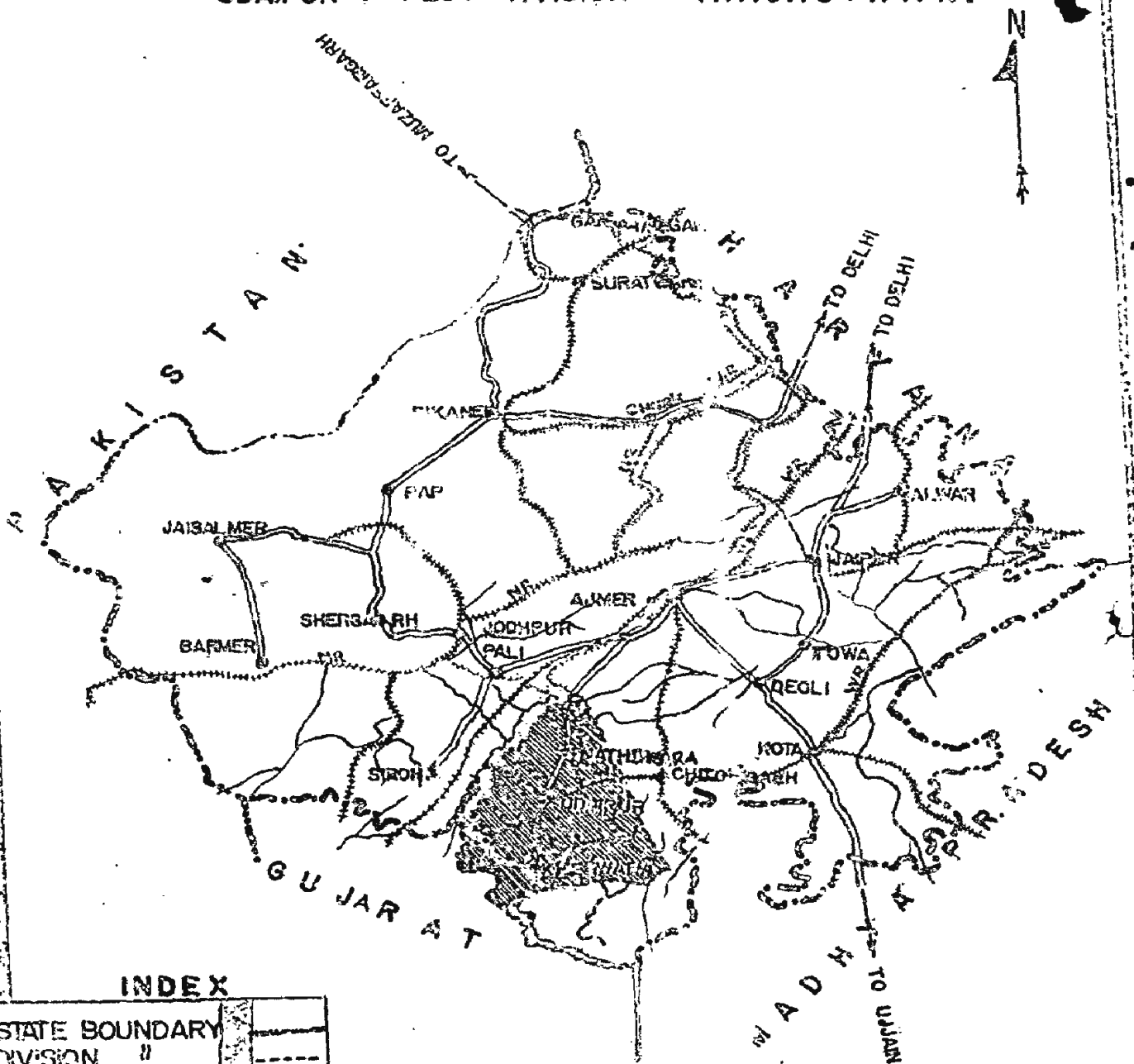


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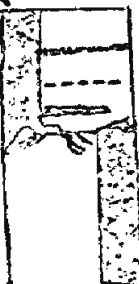
RANGE BOUNDARY = 

REINVESTMENT SURVEY OF FOREST RESOURCES
(NORTH ZONE)
UDAIPUR FOREST DIVISION RAJASTHAN



INDEX

STATE BOUNDARY
DIVISION "
ROADS
RIVERS



CHAPTER - I

1.

THE SURVEY AREA

1.1 GENERAL

Most of the forest resources of Rajasthan are concentrated in the south consisting of Chittorgarh, Udaipur, Sirohi, Banswara and Durgapour districts of the State. These forests are fairly rich in timber and bamboo resources. Realising the importance of forests for industrial development, Rajasthan Forest Department started forest resources survey which is a first step towards planning the forest based industries. For this purpose, a Forest Resources Survey Division was opened with Central Government's assistance. This division completed the survey of forest resources in Sirohi, Banswara, Durgapour and Chittorgarh divisions. A small portion of Udaipur division was also surveyed before the Forest Resources Survey Division was wound up during 1973-74 due to non-availability of funds under Central assistance. The complete knowledge of forest resources in an industrial catchment is necessary before planning for any forest based industry. Udaipur division is a big division which accounts for more than 50% of the forest resources of southern part of the State and no planning for forest industries could be of any use unless the resources of this division are known. Therefore, Rajasthan Forest Department approached the Preinvestment Survey of Forest Resources Organisation to conduct survey in rest of the area of Udaipur Division. Since only a small portion of Udaipur division was surveyed by Forest Resources Survey Division and that too surveyed much earlier, it was decided to survey entire Udaipur division. The survey work by Northern Zone of Preinvestment Survey of Forest Resources Organisation was started in December, 1975 and completed by the end of March, 1977. Special studies viz., Market and Demand Studies, Volume Studies etc., however, were completed in June, 1977. Since survey work in Himachal Pradesh was also going on simultaneously the field work in Rajasthan was confined to winter seasons of 1976 and 1977.

1.2 A R E A

1.2.1 Physical

The survey area consists of Udaipur Forest Division i.e. entire Udaipur district except Bhim Tehsil. The total geographical area is 15206.94 km² and forest area is 4548.45 km². The area lies between 28° - 45' - & 25° - 30' North Latitude and 74° - 30' and 73° - 0' East-longitudes (approx.). The survey area is bounded in north-east by Ajmer district, in south, by Durgapour and Banswara districts, in South-west, by Gujarat State in West by Sirohi and Pali districts and in East by Chittorgarh and Bhilwara districts.

From drainage point of view the area can be divided into three distinct patterns.

- (a) North Eastern to South Western Part :- Here the rivers viz. Sabarmati, Watal etc. flow from North East to South-West direction and drain out in Arabian sea.
- (b) Northern and North-Eastern Part :- In this part the rivers viz. Banas, Berachand, Kheri etc. which are tributaries of Chambal river, flow from North-West to East and North-East direction and ultimately drain into Bay of Bengal.
- (c) Southern Part :- The rivers like Jakham, Som, Sara etc. are tributaries of Mahi river, which drains into Arabian sea through Gulf of Cambay.

1.2.2. Climate

The climate of the area is generally dry with prolonged summers. The year is differentiated by three distinct seasons, namely - hot season (March to June), rainy season (July to September) and cold season (late November to early February). Temperature varies from 10°C (Minimum) in January to 44°C (Maximum) in May. Average rainfall varies from 517.8 mm. to 1308 mm. with 42 average number of rainy days. Rainfall is mostly concentrated in July and August. The distribution of rainfall is given below in Table No. I-1.

Table No. I-1
Distribution of Rainfall

S.No.	Months	Mean Rainfall (mm)	Mean No. of Rainy days.	Max. Rainfall (mm) recorded in 24 hrs.
1	2	3	4	5
1.	January	3.19	0.25	18.3
2.	February	1.68	0.17	13.8
3.	March	15.57	0.42	80.3
4.	April	0.20	0.00	1.0
5.	May	7.22	0.83	25.9
6.	June	72.67	3.75	54.0
7.	July	140.10	8.17	85.6
8.	August	208.25	10.00	133.5
9.	September	102.78	5.17	91.5
10.	October	8.78	0.92	23.0
11.	November	5.50	0.33	21.0
12.	December	0.19	0.00	1.9
	Total	566.13	30.01	-

1.2.3 Topography

Aravalli mountain system dominates the topography of the survey area. A hill range running from North-East to South-West forms a natural boundary separating this area from the western part of the State. Apart from this range, there are innumerable series of detached hills spread all over the area except in North Eastern portion, where the land is comparatively plain. In the heart of the range, there is a plateau at 1250 metres altitude above M.S.L.

1.2.4 Geology, Rock and Soil

In the North-West side Mewar banded gneissic complex is met with which is distinct from Aravalli system. Vindhayan formation also appears in southern part covering mostly Bansi, Dhariawad and part of Salumbar ranges. The geological formations commonly met with are Deccan Trap, Vindhayan, Delhi series, Bailo series, Aravalli system and pre-Aravalli banded Gneiss. Sand stones, lime stones, dolerite basalt, phyllites, gneiss, quartzites etc. are the common rock types usually found in the area.

There are only two important soil types that occur in the area. These are - Black soils and Red soils. Black soils are mainly developed from Basaltic rock and so pre-dominate over most of the Deccan plateau. Black soil contains high percentage of clay and is characterised by deep and wide fissures in the soil in dry season. These soils are generally alkoline in nature, and poor in nitrogen and phosphorus contents but adequately rich in Potash and lime. Humus contents is typically low. Red soils on the other hand, are mainly associated with acid granites, gneisses and schists. They are typically coarse, often with ferric concretions a neutral or acidic reaction, and poor in organic matter and mineral nutrients.

1.2.5 Vegetation

There is a wide variation in the vegetation and its growth from one part to another part of the survey area. In general there is an increase in the amount and variety of tree growth from North to South and East to West. The valleys situated away from villages support quite good forests of fairly tall trees with patches of dense grasses. Northern slopes are generally more wooded and remain green for comparatively longer period during dry season. Near village mango (Mangifera indica), mahua (Madhuca latifolia), ber (Zizyphus jujuba) and less frequently the tamarind (Tamarindus indica) are found singly or in groups and yield edible fruits. Babul (Acacia arabica), khajur (Phoenix sylvestris), palash (Butea monosperma) and small stunted teak (Tectona grandis) trees are quite common around fields in damp valleys and on black cotton soils. In the stream beds and on their banks Karanj (Pongamia pinnata), Jamun (Syzygium cumini) and kareel (Sterculis urens) is very common.

On cut up slopes and exposed rocks the (Euphorbia) finds a congenial home but is seldom found on alluvial soils unless planted.

Good forests are seen on quartzite and conglomerate ranges. Although these forests are sometimes swept away by forest fires which burns grasses and regeneration yet these ranges are densely clothed with a variety of spp. There is a marked distinction between the vegetation on the Aravalli system and Vindhayan system. Teak is generally confined to Vindhayan ranges and is almost absent on Aravalli hills.

1.2.6. Land Use

The break up of the geographical area of the district (except Bhim tehsil) according to different types of land uses is as under :-

1. Total geographical area	= 15,206.94 km ²
2. Forest area	= 1,123.75 km ²
3. Cultivated area	= 3,146.83 km ²
4. Area under tree growth & orchards.	= 10.72 km ²
5. Fallow land	= 846.41 km ²
6. Culturable waste	= 4,055.64 km ²
7. Area not available for cultivation.	= 6,023.59 km ²

Source - Census 1971, Rajasthan - District Udaipur
Table No. 10.

1.2.7 Infrastructure

It is rightly said that the civilisation travels on wires (electricity) and roads. Means of communication do serve as the veins of cultural exchange both in the material and non-material aspects. Till two decades ago there were very few all weather roads in the district. In the interior area there were hardly any roads. The situation has improved to a great extent and the district is now fairly well placed in the State from communication point of view. The district headquarter is connected by rail and road with the important commercial centres in the country. National Highway No. 8 passes through the survey area. Total length of National Highway is 303 kms and the total length of metalled and non-metalled roads in survey area is 1041 kms. and 1156 kms. respectively. The following roads make the effective road communications of the district.

1. Udaipur-Kherwada-Ahmedabad
2. Udaipur-Nathdwara-Ajmer
3. Udaipur-Chittorgarh
4. Udaipur-Gogunda-Pindwara
5. Kherwada-Dungarpur
6. Udaipur-Dhrolwad
7. Udaipur-Salimbar
8. Salubar-Dhrolwad
9. Kherwada-Panarwa-Kotra
10. Kotra-Sarapganj
11. Udaipur-Gogunda-Kotra
12. Udaipur-Gogunda-Panakpur.

Rivers are not navigable and hence river transport is rather un-known in this tract.

Railways

Udaipur lies on Ahmedabad-Chittorgarh route of Western Railway. Total length of railway line falling in the district is 345 kms. However, the railway lines are mostly concentrated in Northern and North-Eastern part which contains very little forests. South-Western part, which is comparatively rich in forest resources is not connected by railway line. Thus, railways do not play any significant role for local transport of forest produce. Following is the list of railway routes passing through the area.

1. Ahmedabad-Udaipur-Chittorgarh
2. Maoli-Bavisadri
3. Maoli-Mewar.

1.2.8 Socio-economic Conditions

More than 87% of the population lives in villages. Rural population consists mainly of Bhils, Bavarias, Garasias, Minas, Patelis and Gujars. The tribal people are mostly shy, superstitious and illiterate and live in remote places far off from civilisation. The tribal population is 33.66% of the total population and more/95% live in village. Literacy percentage is 17.41 as against 19.07 for the State. Rural population is mostly illiterate. The literacy percentage in rural population is only 12.69 and for tribals it is even less than 5 percent.

/than

Rural economy is primarily agriculture based. The agricultural holdings are generally small. Approximately 1,34,000 ha. agriculture land is irrigated which is only 12% of the total geographical area. However, as compared to State's average, the district is well placed from irrigation point of view. Tanks and wells are major source of irrigation. Wheat, barley, maize, rice, gram, sugar-cane, cotton etc. are the main agricultural crops raised in the area.

Cattle rearing is another important field which provides livelihood to rural people. Cattle population in the district is almost double the human population. Cattle are maintained for milk as well as meat.

There is very little industrial activity in the area except in Udaipur town which is developing into an industrial town, rather slowly. There are, however, quite a few cottage/small scale industries in the area among which toy making industry is the most prominent. Quite a good quantity of toys are exported not only to other parts of the country but to foreign countries also. Wrightia tinctoria wood is generally used for toy making.

1.2.9 People

The total geographical area of the district is 17267km^2 which is 5.05% of the total area of the State. The population as per 1971 census is 1.804 million which is 7% of the population of the State. Population density in rural and urban areas respectively is 92 and 1612 persons per km^2 . Over all population density, however, is 104 persons per km^2 . Population density is very low in Kotra, Palasia and Lasaria Tehsils due to extensive forests. The local population chiefly consists of agriculturists and agricultural labourers which is 76.5% of the total population of the district. There is quite a substantial population of tribals in the area. In some tehsils like Kotra, Kherwada, Salumbar etc. the population is predominantly tribal. The tribals and scheduled casts constitute respectively 33.66% and 7.76% of the population of the district. The common tribes are Bhils, Garasias, Menas etc.

1.3 FORESTS

1.3.1 Forest types and Composition

According to the "forest types of India" by Champion and Seth (1968), the forests in the Catchment correspond to the following sub-groups :-

- i) 5A - Southern Tropical Dry Deciduous forests.
- ii) 5B - Northern Tropical Dry Deciduous forests.

5A. Southern Tropical Dry Deciduous Forests

This type occurs in Southern and South-Eastern part of the survey area. Following sub-types are met within this group.

- a) Cl_a - Very Dry Teak Forest
- b) Cl_b - Dry Teak Forests.

5B. Northern Tropical Dry Deciduous Forests

This type occurs generally in Northern, North-Western and North-Eastern parts of the survey area. Following sub-types are generally met within this group.

- a) C₂ - Northern Dry Mixed Deciduous Forests.
Degradation stages of dry deciduous forests.
- b) DS₁ - Dry Deciduous scrubs.
- c) DS₃ - Euphorbia scrubs

Edaphic climax types of dry deciduous forests

- d) E₁ = Anogeissus pendula forest
- e) E₁/DS₁ = Anogeissus pendula scrubs forests
- f) E₂ = Poswellia forest
- g) E₅ = Butea forest
- h) E₆ = Aegle forest
- i) E₈^a = Phoenix sababbah
- j) E₉ = Dry Bamboo brakes.

Seral types of dry deciduous forests

- k) IS₁ = Dry tropical like rain forest.

1.3.2 Demarcation

The total forest area of the Udaipur Forest Division as reported by Rajasthan Forest Department is 10135 km² but till the end of last Working Plan only 4199.36 km² has been demarcated and brought under scientific management. The fate of the balance forests, which are classified as unclassed (un-surveyed) forest is still hanging in balance. Though these forests are supposed to have been transferred to Forest Department long back, yet Forest Department does not appear to exercise effective control on these forests. Most of these forests do not exist now and the forest cover is almost completely removed. Now the Working Plan is under revision and whatever little unclassed (un-surveyed) forests are left are being demarcated and are likely to come under scientific management after the revision of the working plan.

1.3.3 Legal status

All the forests of Udaipur Division are the absolute property of the Government of Rajasthan. Prior to formation of Rajasthan State, these forests were managed by the then Mewar State under two different categories namely - Khalsa forests and Jagir forests. The rulers of the State had full rights over the Khalsa forests. On the other hand, the Jagir forests were managed by the Jagirdars under certain State regulations. After the formation of Rajasthan State, in the year 1953, these forests were brought under Rajasthan Forest Act and were classified as Reserved and Protected forests.

1.3.4 Forest Settlement

The demarcation and settlement work was first started under the Mewar Forest Act of 1942. The forests were classified as Khalsa, Jagir and Bhomat forests having varied degree of proprietary rights of the Government. Mewar Government did not recognise any rights of any-body over these forests. The Rajasthan Government also did not recognise any rights but very liberal concessions have been granted. Rajasthan Forest Settlement Rules 1958 prescribe an annual supply of 0.2 m³ timber per family of five members to the concessionists. This amounts to 60,320 m³ timber annually. For survey area, the requirements for firewood and fencing are not included in this.

There are twelve ranges in the Udaipur Division. Out of the total forest area of approx. 10135 km² only 4199.36 km² was brought under scientific management during the currency of last working plan. As per the working plan in force the area under reserved, protected and un-classed (surveyed) forests is 2988.78 km², 574.71 km² and 635.88 km² respectively. Rest is un-classed (un-surveyed).

1.3.5 Existing Utilization

The wood for domestic purposes such as house construction and repairs, making agricultural implements, fencing material, firewood etc. is supplied free or at reduced rates to local people. Most of the species except Boswellia serrata and Lannea coromandelica occurring locally are used for these purposes. In areas where teak is available, villagers use this timber for house construction and making agricultural implements. Although the area is deficit in wood production yet considerable quantity of firewood/charcoal etc. are exported to Sirohi, Pali and Jodhpur districts, which have practically no forests. The area is quite rich in bamboo resources. Bamboo is used locally for roofing and reinforcement in mud walls, in making doors, windows and cots, fencing the fields, basket and stick making etc. Large quantities of bamboo are exported to Ahmedabad, Ajmer, Jaipur and other places. Small quantities of bamboo waste and Lannea coromandelica wastes are supplied to Gujarat Paper Mill. Wrightia tinctoria is used for turnery works and is supplied at concessional rates to the toy making industries.

The principal marketable products are round timber (small size), charcoal, fuel, grass, bamboos and M.F.P. viz. tendu leaves, honey, wax, gums, bark for tanning etc. Round timber, Charcoal, firewood and bamboos are mostly extracted departmentally by State Trading Divisions. The M.F.P. are, however, extracted through petty contractors.

1.4 AVAILABLE FOREST RESOURCES INFORMATION

The first working plan came into being only in 1962-63 and at that time no enumerations were done to assess the growing stock. This working plan expired in 1971-72, but due to non-revision of the plan, the old working plan is still in force. The working plan is now under revision but no enumerations are contemplated even now. However, Forest Resources Survey Division carried out forest resources survey sometime during 1973, but it covered a very small area and even for this area also the data were not processed. There is hardly any sample plot maintained in the division to study the growth etc. Thus, there is no past information available on growing stock, growth rate etc. Even the reliable forest area information is lacking.

1.5 MAPS AND PHOTOGRAPHY

The survey area is covered by 38 map sheets of 1:50,000 scale. Aerial photography coverage for entire area is also available. Except for small area, the photography is very old and the scale also varies from 1:20,000 to 1:40,000. The details of map sheets and the photography covering the survey area are given in Appendix - I.

CHAPTER - II

INVESTIGATION AND METHODOLOGY

2.1 OBJECTIVES INCLUDING PRECISION

To begin with the following objectives of survey were fixed:-

1. To estimate area under different forest types and prepare forest types map;
2. To estimate total growing stock within $\pm 10\%$ error at 95% probability level;
3. To estimate the growing stock of important timber species and bamboos;
4. To estimate growth rate of important species and prepare weight and volume tables of important species;
5. To find out the extent of potentially productive areas.

The working plan of Udaipur Division was under revision and part of the field work was already over before Preinvestment Survey of Forest Resources Organisation started the field work in December, 1975. After having in depth study of the objectives and the utility of final results Rajasthan Forest Department revised the objectives so that the survey results may be more useful for preparation of working plan. Therefore, the objectives decided finally were as under :-

A. I) For forests under the control of Forest Department (i.e. the forests covered by working plan).

1. To estimate the total growing stock within $\pm 10\%$ error for the division and within $\pm 20\%$ error for ranges/working circles at 95% probability level;
2. To prepare the volume tables of important species;
3. To estimate the total growing stock of bamboo in the division;
4. To estimate the extent of poorly stocked but potentially productive forests which may be considered fit for afforestation.

II) For forests outside the control of Forest Department (i.e. all other forests).

1. To estimate the total growing stock of such forests in the division within $\pm 10\%$ error at 95% probability level.

The Forest Department agreed to supply the area information alongwith maps giving the break up of forest area under different categories viz., ranges, working circles etc.

B. Market & Demand Studies

1. To estimate the present level of wood consumption by the existing population and the industries;
2. To forecast the level of wood consumption in 1980 and 1985.

2.2 AERIAL RECONNAISSANCE PHOTOINTERPRETATION & MAPPING

Since entire area under survey was covered by aerial photography and the maps were also available no aerial reconnaissance was considered necessary. The available photography, however, was very old. The aerial photography of some of the areas like Kotra and part of Panarwa and Jhadol ranges was fairly recent i.e. of 1974, but that of other areas it was as old as 1966 or even earlier. The scale of photography varied from 1:25,000 to 1:40,000. Since the photography of most of the areas was too old lot of changes have taken place during this period, much reliance could not be placed on it for the purpose of estimating the area under forests and forest types. However, photo-interpretation was done by Photointerpretation Section of Preinvestment Survey of Forest Resources Organisation. On the basis of this photo-interpretation land use and forest types maps will be prepared which will give broad indications about the extent and location of different land uses, forests and forest types and possibly the poorly stocked but potentially productive forest areas.

2.3 INVENTORY DESIGN

2.3.1 Plot survey

The Resources Survey Division of Rajasthan Forest Department had carried out fixed plot (size 0.16 ha.) strip sampling in two out of the twelve ranges of the division. These data were used for estimating the co-efficient of variation of the population. In the absence of volume tables for most of the species found in this area the co-efficient of variation for basal area was estimated and was found to be about 75%. The co-efficient of variation for volume for the entire areas was, however, assumed to be 150%.

2.3.2 Number of sample plots and their distribution

Assuming the co-efficient of variation of 150% over the whole survey area 225 sample plots are needed to estimate the total growing stock within 10% standard error. Although total forest area was reported to be 10135 km², but only 4199 km² was covered under the working plan. The fate of rest of area was not known and it was doubtful if the balance area still supports forests. Therefore, it was decided to adopt systematic sampling at $2\frac{1}{2}' \times 2\frac{1}{2}'$ interval to provide at least 225 forested sample plots although total number of sample plots falling in forest area were expected to be about 500.

Later on, however, Rajasthan Forest Department revised the objectives of survey and wanted to know the growing stock by ranges and working circles within 20% standard error. Therefore, the data collected at first stage at $2\frac{1}{2}' \times 2\frac{1}{2}'$ interval were used for estimating the co-efficient of variation for each range and number of sample plots required for sampling for each range was calculated accordingly. A systematic sampling of varying intensity from range to range was finally adopted. The forest management maps based on last working plan and updated by W.P.O. Udaipur Division, showing the compartments, blocks, ranges and working circle boundaries were supplied by the Rajasthan Forest Department. These maps were used for the purpose of stratification into ranges and also estimating the forest area of ranges and the division. The number of sample plots finally selected in each range alongwith the interval between the sampling units is given below :-

S.No.	Range	Sampling interval	Total number of sample plots
1.	Udaipur	$1\frac{1}{4}' \times 1\frac{1}{4}'$	88
2.	Parshad	$1\frac{1}{4}' \times 1\frac{1}{4}'$	81
3.	Salumbar	$1\frac{1}{4}' \times 1\frac{1}{4}'$	59
4.	Kurabar	$1\frac{1}{4}' \times 1\frac{1}{4}'$	36
5.	Kherwada	$2\frac{1}{2}' \times 2\frac{1}{2}'$	52
6.	Gogunda	$1\frac{1}{4}' \times 1\frac{1}{4}'$	38
7.	Bansi	$1\frac{1}{4}' \times 1\frac{1}{4}'$	52
8.	Penarwa	$2\frac{1}{2}' \times 1\frac{1}{4}'$	52
9.	Jhadol	$2\frac{1}{2}' \times 1\frac{1}{4}'$	43
10.	Kotra	$2\frac{1}{2}' \times 2\frac{1}{2}'$	40
11.	Dhariawad	$2\frac{1}{2}' \times 1\frac{1}{4}'$	44
12.	Kumbalgarh	$1\frac{1}{4}' \times 1\frac{1}{4}'$	104
Total			689

2.3.3 Layout of sample plots on maps

Each 5' longitudinal and latitudinal interval on the map was sub-divided into four equal parts of $1\frac{1}{4}'$. The intersections of these longitudinal and latitudinal lines at $1\frac{1}{4}'$ interval were centres of the sample plots. As explained earlier the sample plots were at $1\frac{1}{4}' \times 1\frac{1}{4}'$ and $2\frac{1}{2}' \times 2\frac{1}{2}'$ or $2\frac{1}{2}' \times 1\frac{1}{4}'$ interval depending upon the intensity of survey required in different ranges.

2.3.4 Stratification

In its true sense no stratification was done. However, Rajasthan Forest Department supplied the old management maps which were used for pre-stratification of forests into ranges and working circles. The working plan was under revision and quite a few changes in area allotment to working circles were expected. On the contrary, the range boundaries are of comparatively permanent nature. Therefore, basing on old maps, pre-stratification was done for ranges only.

2.3.5 Layout of sample plots on the ground

The sample plots were located on the ground with the help of maps and photographs and by measuring the distances and taking bearings from selected conspicuous reference points. Fixed plot method was adopted. Square plot of 0.16 ha. area was adopted for the present survey. Field data were recorded in the following forms:-

- i) Plot Description Form
- ii) Plot Enumeration Form
- iii) Sample Tree Form
- iv) Bamboo Enumeration Form

For details of procedure, Para I of Volume II of this report may be referred to.

2.4 DEMAND AND MARKET STUDIES

Present production figures were collected from Annual Administration Reports and other relevant records. Sample survey was conducted to estimate the wood requirement for construction and repairs of houses, agricultural implements and for fuel. All the wood based industries in the survey area were visited and wood consumption by these industries was recorded. All available data regarding wood production and consumption were collected and have been quoted in the report.

2.5 DATA PROCESSING

2.5.1 Inventory Data Processing

Data processing involved documentation of information punching the data on cards, their arrangement in proper sequence, loading the data in the magnetic disks, consistency checking by the electronic computer, corrections in the disk, calculation of felled tree volume, derivation of volume equations, calculation of volume of the enumerated trees and plot volumes, preparation of volume tables etc.

The raw data from field forms were transferred to punch cards with punching machine. The punch cards were verified in a card verifier and then sorted out and arranged in proper order with the help of sorter and collater. Consistency checking of the data was done by the electronic computer after preparing suitable computers programmes. Under bark and over bark volumes of felled trees were calculated by Smalian's formula. Local volume equations for Tectona grandis, Anogeissus latifolia, Lannea coromandelica, Roswellia serrata and for rest of the species were derived.

For details of data processing and the formulae used, Part III of Volume II of this Report may be referred to.

2.5.2 Market & Demand Studies Data Processing

The data processing has been done manually. The data for wood production collected from various sources was added up to work out the total wood production in the survey area. On the basis of sample survey, per capita consumption of wood for different purposes viz., house construction, agricultural implements, fuel etc. was estimated and the total wood consumption by the local population was worked out. The demand of wood for the year 1980 and 1985 has been projected after taking into account the expected growth in population and changes in the income structure. On the basis of projected demand and annual cut, the wood balances have been worked out for the year 1980 and 1985.

2.6 FIELD WORK

The field work was started towards the end of December, 1975, and as per original design the inventory work was to be over by the end of March, 1976. However, due to revision of objectives the design was modified and some more work had to be done. Due to non-availability of management maps and other relevant information the field work could not be continued beyond March, 1976. Later on when the relevant information was made available by the Rajasthan Forest Department, the field work was again started towards the end of December, 1976. Inventory work was over by about middle of March, 1977. Market & Demand Study work, however, continued beyond April and was finally completed by the end of June, 1977.

CHAPTER - III

DATA ANALYSIS

3.1 AREA STUDIES

Rajasthan Forest Department supplied the management maps of Udaipur Division showing the boundaries of the division, ranges, blocks, compartments etc. The forest area under different ranges was calculated by planimetry. Since the allotment of blocks/compartments to different working circles was not finalised by the Working Plan Officer, the area under different working circles could not be calculated. Total geographical area is 15207 km² and the forest area (i.e. land under control of Forest Department) is 4548.45 km². Distribution of forest area in Ranges is given below :-

Table No. III-1

Range-wise distribution of forest area

S.No.	Name of Range	Forest area in km ²	% of total forest area	Total No. of survey plots
1.	Udaipur	388.25	8.54	88
2.	Parsad	384.33	8.45	81
3.	Salunbar	233.97	5.14	59
4.	Kurabar	196.71	4.33	36
5.	Kherwada	400.38	8.80	52
6.	Gogunda	162.31	3.57	38
7.	Bansi	252.68	5.56	52
8.	Panarwa	425.39	9.35	52
9.	Jhadol	477.08	10.49	43
10.	Kotra	745.66	16.39	40
11.	Dhariawad	456.33	10.03	44
12.	Kumbalgarh	425.36	9.35	104
	Total	4548.45	100	689

3.1.1 Forest Types

The following forest types were recognised for the purpose of this survey:-

1. Teak (Tectona grandis) forests - where teak alone constitutes 50% or more of the crop.
2. Dhok (Anogeissus pendula) forests - where Anogeissus pendula alone constitutes 50% or more of the area.

3. Salar-Godal (Lannea coromandelica - Roswellia serrata) forests - Where Roswellia serrata and Lannea coromandelica both taken together constitute 50% or more of the crop.
4. Mixed Misc. forests with Teak: Mixed misc. forests having teak more than 10% but less than 50% of the crop.
5. Mixed Misc. forests without teak: Mixed misc. forests having teak less than 10% of the crop.
6. Others: All other forests not falling in any of the above categories.

3.1.2 Area Under Different Forest Types

The percentage of sample plots falling under each forest type in each range is calculated. From this the average percentages for the entire division have been calculated by giving the weightage by area of ranges and the area under different forest types has been calculated by multiplying the total forest area by these percentages. The distribution of forest area by forest types thus calculated is given below in Table No. III-2.

Table No. III - 2
Distribution of Forest Area by Forest Types

S.No.	Forest Type	Percentage area	Area in km ²
1.	Teak	7.82	355.822
2.	Dhok	0.39	17.809
3.	<u>Salar & Godal</u>	45.31	2060.998
4.	Mixed Misc. with teak	11.10	505.133
5.	Mixed misc. without Teak	31.61	1437.480
6.	Others	3.77	171.204
	Total	100.00	4548.446

The range and forest type-wise distribution of forest area is given in appendix in Table No. 1.

It may be seen from Table No. III-2 and Table No. 1 (appendix) that the teak forests constitute 7.82% area of the division and are mainly confined to Salumbar, Bansi, Dhariawad and to some extent to Kherwada ranges. Dhok forests constitute only 0.39% area and are confined to Udaipur and Kurabar Ranges only. Salar-Godal forests cover the maximum area (45.31%) and are found almost in all the ranges. It is, however, interesting to note that percentage

area under Salar-Codai type is generally on higher side in ranges having higher biotic interference except in Kotra and Kumbalgarh ranges where preponderance of higher hills may account for this phenomenon.

3.1.3 Biotic Interference

Four categories of biotic interference viz., very heavy, heavy, moderate and light have been recognised. For details part I of Volume II of the Report may be referred to.

3.1.4 Area under different categories of biotic interference

The percentage of sample plots falling under each category of biotic interference has been calculated in the manner stated in para 3.1.2 and by multiplying these percentages with the total forest area of the division, the forest area under different categories is estimated. Same is given below in Table No. III-3.

Table No. III-3
Distribution of forest area under different
category of biotic interference

S.No.	Biotic interference	Percentage area	Area in km ²
1.	Very heavy	14.78	672.171
2.	Heavy	26.21	1192.219
3.	Moderate	47.08	2141.590
4.	Light	11.93	542.466
Total		100.00	4548.446

The forest area under various categories of biotic interference in ranges is given in appendix in Table No. 2.

From Table No. III-3 and Table No. 2 it may be noted that the biotic interference is generally very heavy. Biotic interference in Udaipur, Parsad, Salumbar and Kurabar ranges is comparatively heavy.

3.1.5 Regeneration status

Four categories of regeneration status i.e. Profuse, adequate, scanty and nil have been recognised. For details of the definitions of these categories, Part I of Volume II of the Report may be referred to.

3.1.6 Forest area under different categories of regeneration status.

Same method as discussed in previous paras has been adopted to estimate the area under different regeneration categories and same is given in Table No. III-4.

Table No. III-4.

Distribution of forest area under different regeneration categories

S.No.	Regeneration status	Percentage area	Area in km ²
1.	Profuse	1.19	54.341
2.	Adequate	7.01	319.105
3.	Scanty	41.11	1869.526
4.	Nil	50.69	2305.474
	Total	100.00	4548.446

Distribution of forest area under different regeneration categories in ranges is given in Appendix in Table No. 3.

It may be noted from Table No. III-4 and Table No. 3 (appendix) that regeneration is almost absent in most of the area. In four ranges natural regeneration is totally absent.

3.1.7 Forest Potential (i.e. poorly stocked but potentially productive areas)

Such areas where density of forest cover is less than 0.4 but the nature of vegetative cover and soil conditions indicate that the site can support much better forests have been identified. They are called poorly stocked forests but potentially productive—simply - 'potential areas'. For details part I of Volume II may be referred to. The area under different categories of forest potential is given below in Table No. III-5. Range-wise distribution of potential forest area is given in Appendix in Table No. 4.

Table No. III-5

Forest area under different potential classes

S.No.	Forest Potential class	Percentage area	Area in km ²
1.	Potential	32.56	1481.048
2.	Not Potential	4.10	186.446
3.	Not applicable	63.34	2880.952
	Total	100.00	4548.446

3.2 TREE VOLUME STUDIES

3.2.1 Preparation of Volume Tables

In order to prepare volume tables, felling of trees was undertaken in all forest types scattered over the entire survey area. A random selection of sample plots as well as of the trees in the sample plots was made and the trees so selected were felled and measurements recorded. Due to non-availability of sufficient trees in higher diameter classes, the trees in ~~these classes were selected, at times around the sample plot~~ wherever available. For details of the procedure, Part I of Volume II of this Report may be referred to.

Table No. III-6 gives the number of trees felled for preparation of volume tables.

Based on felled tree data and the sample tree data local volume equations were derived for Tectona grandis, Roswellia serrata, Lannea coromandelica, Anogeissus latifolia and rest of species. The following equations were selected after taking into consideration the standard error of estimate, the multiple determination co-efficient and the applicability of the equation, in the entire range of data.

<u>Species</u>	<u>Equations</u>
<u>Tectona grandis</u>	$V = 0.062108 - 0.927983 D + .613031 D^2$
<u>Roswellia serrata</u>	$V = -0.155316 + 2.714875 D$
<u>Lannea coromandelica</u>	$V = 0.046731 - 0.962906 D + 7.301883 D^2$
<u>Anogeissus latifolia</u>	$V = -0.004378 + 4.575823 D^2$
Rest of species	$V = 0.081467 - 1.063661 D + 6.452918 D^2$

Where -

V = Under bark tree volume (m^3) upto a limit of 5 cm. over bark diameter.

D = Over bark diameter (m) at breast height.

3.2.2 Volume Tables

The local volume table of these species is given in Table No. III-7. The above mentioned volume equations are applicable to 10 cm. and above diameter (D.B.H.O.B.) trees. The volume for trees diameter class 5-10 cm. is calculated on the basis of average volume of the trees felled in this class and same is given in the table against mid diameter (7.5 cm.).

Table No. III-6

No. of felled trees used in General Volume Equations

Species	Breast height Over bark diameter classes in Cm.											Total
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	
<u>Mogelissus latifolia</u>	30	28	12	10	10	9	4	4	-	-	-	107
<u>Lannea coromandelica</u>	10	17	20	16	9	9	10	6	-	-	-	97
<u>Tectona grandis</u>	26	19	21	20	20	9	3	2	-	-	-	120
<u>Roswellia serrata</u>	9	12	13	15	12	11	8	4	1	-	1	86
Rest of species	52	82	46	18	14	13	8	7	-	2	-	242
Total	127	158	112	79	66	51	33	23	1	2	1	652

Table No. III-7

Local Volume Table

Diameter breast ht. (O.B.) cm.	Volume m ³				
	<u>Anogeissus</u> <u>latifolia</u>	<u>Leucaena</u> <u>coromanda-</u> <u>delica</u>	<u>Boswellia</u> <u>serrata</u>	<u>Tectona</u> <u>grandis</u>	Rest of species
7.5	.017	.009	.013	.013	.013
10.0	.043	.040	.035	.036	.012
12.5	.057	.066	.038	.048	.032
15.0	.067	.098	.063	.069	.062
17.5	.093	.133	.100	.102	.103
20.0	.127	.178	.248	.142	.152
22.5	.169	.226	.200	.190	.207
25.0	.221	.283	.263	.245	.271
27.5	.277	.343	.334	.306	.346
30.0	.344	.343	.334	.306	.346
32.5	.414	.407	.412	.377	.433
35.0	.494	.479	.500	.456	.523
37.5	.584	.556	.604	.542	.628
40.0	.684	.640	.712	.639	.734
42.5	.786	.724	.830	.745	.861
45.0	.898	.818	.956	.853	.996
47.5	1.022	.922	1.039	.977	1.130
50.0	1.157	1.024	1.235	1.106	1.278
52.5	1.296	1.138	1.390	1.252	1.442
55.0	1.453	1.255	1.555	1.394	1.604
		1.383			

3.2.3 Utility Volume

While sectioning the trees for volume studies, the utilisation of timber was kept in mind. As desired by Rajasthan Forest Department 21 utility classes were recognised. For details of utility classes, their specifications etc. Part I of Volume II may be referred to. Teak, Dhawra, Salor and Godal are the four most important species from the point of view of occurrence in the area. Teak, Dhawra, and misc. species are mostly used for Lath, Pat, Ballies, Poles Cathey etc. At present Salor & Godal are not used for any purpose on commercial scale, and their proper utilisation is one of the problems faced by the Forest Department. Therefore, keeping in view the occurrence,

Present utilisation, future prospects of utilisation etc. the study of utility volume in respect of Salar was restricted to match splints and that of Godal to packing cases and plywood only. All other species were considered for all uses except match splints, packing cases and plywood. The volume per piece and percentage volume in each utility class is given in Table III-8.

Table No. III-8

Utility volume expressed as percentage of total under bark volume

S.No.	Utility class	Av. Vol/ piece in m ³	Volume expressed as percentage of total under bark volume of respective species/group of species		
			<u>Boswellia</u> <u>serrata</u>	<u>Lannea</u> <u>coroman-</u> <u>delica</u>	All other species
1.	<u>Lath</u>	0.183	-	-	6.3
2.	<u>Pat</u>	0.079	-	-	1.8
3.	<u>Balewan</u>	0.060	-	-	4.1
4.	<u>Ballies-I</u>	0.037	-	-	1.2
5.	<u>Ballies-II</u>	0.024	-	-	1.9
6.	<u>Ballies-III</u>	0.019	-	-	0.3
7.	<u>Ballies-IV</u>	0.016	-	-	2.1
8.	<u>Poles-I</u>	0.012	-	-	0.2
9.	<u>Poles-II</u>	0.008	-	-	0.9
10.	<u>Poles-III</u>	0.007	-	-	0.3
11.	<u>Gathey-I</u>	0.005	-	-	0.7
12.	<u>Gathey-II</u>	0.014	-	-	1.8
13.	<u>Gathey-III</u>	0.017	-	-	1.5
14.	<u>Gathey-IV</u>	0.030	-	-	7.0
15.	<u>Gathey-V</u>	0.052	-	-	5.6
16.	<u>Gathey-VI</u>	0.117	-	-	25.4
17.	Packing cases	0.037	-	28.6	-
18.	Match splints	0.153	67.2	-	-
19.	Plywood	0.144	-	41.2	-
20.	Fuelwood	0.018	36.3	34.5	37.9
21.	No utility	0.004	6.9	7.7	8.3
Total		-	110.4	112.0	107.5

Note:- The totals of Col. 4,5 & 6 exceed 100 because the fuelwood and no utility volumes have been measured over bark, while all other volumes have been measured under bark and percentages have been calculated on total under bark volume of respective species/group of species.

3.2.4 Bark volume

The bark percentage in different diameter classes has been calculated and given below in Table No. III-9.

Table No. III-9.

Bark Volume expressed as percentage of Tree Volume (U.B.)
by species & diameter classes

Species	Diameter classes (U.B.) in cm.						
	10-15	15-20	20-25	25-30	30-35	35-40	40+
<u>Anogeissus latifolia</u>	16.0	14.1	12.5	11.0	10.0	9.4	9.1
<u>Lannea coromandelica</u>	50.5	46.6	43.0	39.7	36.4	33.4	30.6
<u>Tectona grandis</u>	30.3	26.2	22.0	19.4	18.1	17.3	16.3
<u>Boswellia serrata</u>	40.0	36.1	32.5	29.3	26.4	24.4	23.2
Rest of species	32.1	29.3	27.0	25.7	25.0	24.5	24.1

It would be clear from the above table that bark percentage decreases towards higher diameter classes for all the species. The bark volume percentage in all diameter classes are the highest in case of Godal followed by Salar and lowest in case of Dhawra.

3.2.5 Cull Volume/Hollowness

Cull means the defects in wood which make it unsuitable for use. The data for cull volume were collected from felled trees but considering its limited utility in present case primarily because of very small sized wood available in the area which mostly is utilizable in the form of round pieces, the cull volume was not estimated. However, the percentage of hollow trees by diameter classes has been estimated and the same is given in Table No. III-10.

Table No. III-10

Percentage of hollow trees by species & diameter classes

Species	B.H			Diameter (O.B.) in cm.		
	5-10	10-20	20-30	30-40	40-50	50+
<u>Anogeissus latifolia</u>	3.7	13.2	31.9	54.7	81.9	-
<u>Lannea coromandelica</u>	0	0	1.7	4.8	7.4	-
<u>Tectona grandis</u>	4.2	12.4	35.1	64.5	99.4	-
<u>Boswellia serrata</u>	9.8	12.2	18.0	27.0	37.8	49.4
Rest of species	3.2	7.6	14.5	27.4	53.4	86.7

Percentage of hollow trees is generally higher in higher diameter classes. Hollowness is very high in some of the higher diameter classes. For example, in case of teak, almost cent percent trees become hollow beyond 40 cm. diameter. Even in lower classes i.e. 20-30 & 30-40 hollowness percentage is very high. It would thus, appear that it may not be advisable to grow Anogeissus latifolia and Tectona grandis beyond 20 cm. diameter though Lannea coromandelica and Boswellia serrata may possibly be allowed to grow upto 50 cm. diameter.

3.3 TREE DENSITY STUDIES

Number of stems per ha. by diameter classes has been calculated and is given in Table No. III-11. This table gives the figures for entire division. Rangewise distribution of stems/ha. is given in table No. III-12. Range and specieswise distribution of stems/ha. is given in appendix in Table Nos. 5 to 16.

It may be noted from these tables that stem density i.e. stems per ha. is fairly high but 76.8% stems are below 15 cm. diameter and only 1.2% stems are above 40 cms. diameter. Preponderance of higher diameter classes is maximum in case of Boswellia serrata followed by Lannea coromandelica and Terminalias. In case of Tectona grandis, Anogeissus latifolia and Wrightia tinctoria only 4% stems are above 20 cm. diameter and for Acacia catechu this percentage is only 2%. In case of Boswellia serrata about 53% stems are above 20 cm. diameter and 7% above 40 cm. From stem density point of view, Anogeissus latifolia occupies the first place followed by Tectona grandis, Lannea coromandelica, Wrightia tinctoria, Boswellia serrata, Diospyros melanoxylon etc.

Stem density is very poor i.e. less than 200 stems/ha. in Udaipur, Parsad, Salumber and Kurabar ranges. It is lowest in Parsad range and highest in Panarwa range. Teak predominates in Salumber, Bansil and Dhariawad ranges. In other ranges except Kherwara teak is almost absent and Anogeissus latifolia, Lannea coromandelica and Boswellia serrata occupy the predominating position. Wrightia tinctoria is found scattered almost in all ranges but its percentage is considerably higher in non-teak bearing ranges as compared to teak bearing ranges. Diospyros melanoxylon also is found scattered almost in all ranges except in Gogunda where it is totally absent but its percentage is comparatively higher in Salumber, Kherwara, Bansil, Panarwa, Kotra and Dhariawad ranges.

3.4 VOLUME STUDIES

Volume has been calculated separately for Tectona grandis, Anogeissus latifolia, Lannea coromandelica and Boswellia serrata only. For rest of the species, a common volume equation has been developed and volume tables were prepared accordingly. Distribution of volume/ha. of different important species by diameter classes for the entire division is given in Table No. III-13 and for ranges it is given in Table No. III-14. Volume per ha. of important species by diameter classes for different ranges is given in appendix in Table No. 17 to 28.

It may be noted from these tables that stocking is generally very poor. Average stocking in the division is only 26.012 m³ per ha. Lannea coromandelica and Boswellia serrata which are comparatively less important from utility point of view account for about 46% of the growing stock. The stocking of Boswellia serrata, Lannea coromandelica, Anogeissus latifolia and Tectona grandis respectively is 28.6%, 17.1%, 10.4% and 5.1% of the total growing stock. Misc. species account for the balance 38.8% growing stock.

There is a considerable variation in stocking from range to range. Stocking in Kurabar range is the lowest which is only 12.881 m³/ha. and highest in Kotra range (38.399 m³/ha). The stocking is comparatively poor in Udaipur, Parsad, Salumber and Kurabar ranges and Boswellia serrata and Lannea coromandelica account for more than 60% of the growing stock in these ranges. It will be interesting to note that more than 70% of the area (see Table No. 2) in these ranges falls under 'Very heavy' and 'heavy' categories of biotic interference. Therefore, the reasons for low stocking and higher percentage of comparatively less important species appear to be biotic rather than climatic. Stocking of Lannea coromandelica and Boswellia serrata in Kotra and Kumbalgarh ranges is also quite high (53%) although biotic interference is comparatively less. Comparatively higher altitude in these ranges perhaps can account for this phenomenon.

Table No. III-11

Stems per Hectare in by Species and Diameter classes (All Ranges)

Species	Diameter classes in Cm. (BHOB)										Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40 +				
<i>Terminalia belerica</i>	0.277	0.274	0.222	0.081	0.071	0.037	0.042	0.074	1.079	0.3		
<i>Ingeiissus latifolia</i>	43.992	12.689	3.710	1.526	0.715	0.153	0.058	0.073	62.916	19.7		
<i>Ingeiissus pendula</i>	0.995	0.360	0.202	0.092	0.80	0.005	-	-	1.734	0.6		
<i>Lannea coromandelica</i>	8.597	7.802	5.407	4.339	2.673	1.593	0.769	0.463	31.643	9.9		
<i>Adina cordifolia</i>	0.476	0.309	0.176	0.136	0.064	0.076	0.133	0.182	1.552	0.5		
<i>Andia catechu</i>	4.701	1.104	0.142	0.067	0.027	0.014	-	-	6.055	1.9		
<i>Brightia tinctoria</i>	17.611	5.849	1.901	0.918	0.199	0.036	0.030	-	26.544	8.3		
<i>Terminalia tomentosa</i>	1.223	0.905	0.382	0.178	0.133	0.044	-	0.070	2.920	0.9		
<i>Tectona grandis</i>	23.313	8.206	2.900	0.886	0.333	0.144	0.040	0.026	35.848	11.2		
<i>Roswellia serrata</i>	3.662	4.364	4.053	3.973	3.842	2.392	1.493	1.744	25.523	8.0		
<i>Diospyros melanoxylon</i>	15.437	5.385	2.057	0.737	0.308	0.148	0.026	0.014	24.112	7.6		
<i>Milusa tomentosa</i>	3.795	1.312	0.416	0.171	0.038	0.058	0.025	0.038	5.853	1.8		
Rest of species	51.215	21.148	10.193	5.246	2.609	1.311	0.587	1.049	93.658	29.3		
Total	175.299	70.007	31.761	18.350	11.072	6.011	3.204	3.733	319.437			
Percentage	54.9	21.9	9.9	5.7	3.5	1.9	1.0	1.2		100.0		

Table No. III-12
Stems per Hectare by Species and Ranges

Species	Name of Ranges										Average for garh Div.
	Udaipur	Parsad	Salambar	Kurabar	Kherwara	Gogunda	Bansi	Panarwa	Jhadol	Kotra	Dharwad Kumbalgarh
<u>Terminalia</u>											
<u>belerice</u>	0.210	0.078	0.538	-	1.681	0.975	-	3.235	22340	1.600	0.140 0.240 1.079
<u>Anogeissus</u>											
<u>latifolia</u>	26.489	26.935	11.025	7.483	74.034	118.587	33.899	85.340	80.522	109.930	55.240 52.052 62.916
<u>Anogeissus</u>											
<u>pendula</u>	4.474	0.078	-	1.652	0.117	-	0.239	0.351	0.146	0.160	- 12.628 1.734
<u>Lannea</u>	22.671	23.847	15.359	9.198	31.968	34.054	44.708	50.245	29.944	37.310	36.797 24.198 31.643
<u>coromandellica</u>											
<u>Adina</u>											
<u>cordifolia</u>	-	0.467	0.211	-	0.840	2.460	0.726	5.22	3.219	2.400	0.280 0.307 1.552
<u>Lecyda</u>											
<u>catechu</u>	6.677	1.315	0.320	5.904	14.180	2.962	9.979	4.203	0.459	2.080	17.891 6.625 6.055
<u>Wrightia</u>											
<u>tinctoria</u>	18.824	14.046	9.655	6.605	9.255	63.983	9.271	47.723	36.338	42.300	8.088 35.524 26.544
<u>Terminalia</u>											
<u>tomentosa</u>	-	-	0.109	-	9.139	-	1.443	16.138	1.169	0.640	2.273 - 2.920
<u>Nectona</u>											
<u>grandis</u>	-	8.027	86.130	-	32.097	-	142.556	7.212	13.235	5.120	165.194 5.561 35.848
<u>Boswellia</u>											
<u>serrata</u>	32.386	32.713	14.618	19.430	39.181	31.085	9.024	14.660	15.256	28.840	12.067 47.403 25.523
<u>Phospyros</u>											
<u>melanoxylon</u>	1.701	2.941	17.378	1.909	35.214	-	37.136	74.042	11.040	34.770	32.310 5.330 24.112
<u>Milisa</u>											
<u>tomentosa</u>	1.128	0.070	2.013	-	11.660	4.308	1.089	21.149	5.524	7.690	0.709 3.441 5.853
Rest of											
species	59.714	42.030	34.515	55.249	84.648	101.235	95.029	196.368	130.455	108.750	52.905 93.215 93.650
Total	174.274	152.555	192.077	107.340	344.024	359.997	365.099	526.866	329.627	382.080	390.394 230.504 319.437

Table No. III-13

Volume (m³) per Hectare by Species and Diameter class (Mairpur Division)

Species	Diameter classes Breast height (D.B.) in cm.									
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	Total	%
<u>Albizia latifolia</u>	0.747	0.758	0.466	0.325	0.233	0.066	0.038	0.062	2.694	10.4
<u>Leuca coromandelica</u>	0.077	0.304	0.522	0.638	0.855	0.778	0.524	0.553	4.451	17.1
<u>Tectona grandis</u>	0.303	0.383	0.275	0.162	0.091	0.065	0.026	0.027	1.332	5.1
<u>Boswellia serrata</u>	0.047	0.145	0.399	0.802	1.316	1.235	1.081	2.407	7.432	28.6
<u>Ipst</u>	1.244	1.740	1.378	1.217	0.936	0.704	0.483	2.401	10.103	38.8
Total	2.418	3.330	3.033	3.344	3.431	2.848	2.152	5.450	26.012	
Percentage	9.3	12.8	11.7	12.8	13.2	10.9	8.3	21.0	100.0	

Table No. III-14

Volume/hectare (in m³) by Ranges and Species

Name of Ranges	<u>Progeissus</u> <u>latifolia</u>	<u>Lannea</u> <u>coromandelica</u>	<u>Tectona</u> <u>grandis</u>	<u>Roswellia</u> <u>serrata</u>	Rest of species	Total of all species	Standard error (%) (all species combined)
Udaipur	1.048	2.586	-	6.269	4.445	14.348	11.32
Parsad	1.302	2.855	0.182	7.204	3.864	15.407	10.51
Salumber	1.185	4.013	2.463	5.292	4.080	17.033	11.47
Kurabar	0.416	2.441	-	6.524	3.500	12.881	18.43
Kherwara	3.254	2.871	1.030	5.789	10.840	23.784	11.34
Gogurda	5.065	3.325	-	5.642	9.059	23.091	13.44
Bansi	1.885	5.157	4.840	5.250	8.506	25.638	9.98
Panarwa	2.673	6.059	0.462	3.516	18.442	31.152	9.06
Jhadol	3.376	2.533	0.449	4.198	12.813	23.372	13.65
Kotra	3.843	6.652	0.164	13.618	14.122	38.399	9.10
Dhariawad	3.355	6.213	6.942	5.437	7.721	29.668	8.23
Kumbalgarh	2.913	4.531	0.188	12.671	12.066	32.369	8.69
Average for the Division	2.694	4.451	1.332	7.432	10.103	26.012	
Standard error (%) (Division)	6.68	6.30	8.96	8.51	5.86	3.32	

3.5 BAMBOO OCCURRENCE STUDY

For estimating the growing stock of bamboo, three size classes and two quality classes of clumps were recognised. The details of size and quality classes, occurrence etc. are given in Part I of Volume II. Distribution of number of clumps per ha. by size and quality classes for entire division is given in Table No. III-15. The averages are based on the total Bamboo occurrence area and not on total area of the division.

Table No. III-15

Bamboo clumps/ha. by quality and size classes (in bamboo) occurring area of the Division.

Quality	Size class-I	Size class-2	Size class-3	Total
I.	95.36	57.79	21.21	174.36
II	26.85	12.46	4.73	44.04

The distribution of clumps/ha. as well as total clumps by size and quality classes in different ranges is given in appendix in Table No. 29 & 30.

A detailed study of culms regarding their age, size, condition etc. in certain randomly selected clumps was also done and the results of this study are given below in Table Nos. III-16, III-17 & III-18.

Table No. III-16

Average Number of sound, damaged and dry-rotten culms per culms per culms by quality and size class

Quality	Size class	Sound S	Damaged D	Dry-Rotten DR	Total
I	1	4.88	3.24	3.52	11.64
	2	9.98	4.72	7.50	22.20
	3	15.46	7.29	11.06	33.81
II	1	3.34	5.60	6.49	15.43
	2	6.45	7.95	8.51	22.91
	3	7.31	4.94	6.13	18.38

Table No. III-17

Average Number of one season, two season and three season old culms per clump by quality and size class

Quality	Size class	One season	Two season	Three season and more season.	Total
I	1	1.35	2.89	7.40	11.64
	2	2.60	4.59	15.01	22.20
	3	4.29	5.50	24.02	33.81
II	1	1.24	3.71	10.48	15.43
	2	1.76	5.15	16.00	22.91
	3	2.25	1.69	14.44	18.38

Table No. III-18

Average culm diameter (cm) at B.H. and Height (m) by clump size and quality class

Quality	Size Class - I		Size class-2		Size class -3	
	Diameter	Height	Diameter	Height	Diameter	Height
I	2.28	2.40	2.62	2.91	3.02	3.50
II	1.79	1.71	2.05	2.03	2.06	2.36

It may be observed from the above tables that the clumps are generally very congested and the number of new recruits is very low. On an average, there are only 2.24 new recruits per clump which is only about 10% of the total culms per clump. The proportion of damaged and dry-rotten culms is very high. On an average 62% of the total culms per clump are damaged and dry-rotten. The number of clumps per ha. is variable from range to range and so also the quality. Bamboo resources in Panarwa, Jhadol and Kotra ranges are comparatively of better quality.

CHAPTER - IV

GROWING STOCK AND YIELD

4.1 INVENTORY RESULTS

4.1.1 Total stems

The total number of stems in the division by species and diameter classes is given in Table No. IV-1. Distribution of total stems of important species in different ranges is given in Table No. IV-2. Rangewise distribution of total stems by species and diameter classes is given in appendix in Table Nos. 31 to 42.

4.1.2 Total growing stock

Distribution of total volume in the division by species and diameter classes is given in Table No. IV-3. Distribution of total volume of important species in different ranges is also given in Table No. IV-4. Rangewise distribution of total volume by species and diameter classes is given in Table Nos. 43 to 54 in appendix.

Table No. IV-1

Distribution of stems (in 1000) by species & Diameter classes

Species	Diameter class in Cm. (BHOB)							
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+
<i>Terminalia</i>								
<i>belerica</i>	126.042	124.862	101.182	37.060	32.318	17.091	19.595	33.845
<i>Anogeissus</i>								
<i>latifolia</i>	20009.713	5771.653	1687.616	694.279	325.248	69.754	26.677	35.425
<i>Anogeissus</i>								
<i>pendula</i>	452.577	163.635	91.832	41.926	36.592	2.552	-	-
<i>Panner</i>								
<i>coromandelica</i>	3910.307	3548.839	2459.293	1973.545	1215.810	724.902	349.891	210.496
<i>Mina</i>								
<i>cordifolia</i>	216.274	140.767	79.942	61.754	28.905	34.354	62.631	82.650
<i>Acacia</i>								
<i>catechu</i>	2138.192	502.281	64.321	30.625	12.491	6.388	-	-
<i>Wrightia</i>								
<i>tincitoria</i>	8010.475	2865.706	864.844	417.423	90.399	16.400	13.579	-
<i>Terminalia</i>								
<i>tomentosa</i>	558.553	411.698	173.776	20.799	51.585	19.894	-	31.689
<i>Tectona</i>								
<i>grandis</i>	10603.977	3732.349	1319.328	403.061	151.326	65.212	18.110	12.071
<i>Boswellia</i>								
<i>serrata</i>	1665.789	1965.027	1843.706	1807.092	1747.278	1038.064	679.240	793.208
<i>Leospyros</i>								
<i>melanoxylon</i>	7021.383	2449.179	335.676	335.236	139.912	67.256	11.930	6.388
<i>Milusa</i>								
<i>tomentosa</i>	1726.188	596.919	189.641	78.055	17.469	26.413	11.365	17.374
Rest of spp.	23295.144	9755.349	4636.519	2386.261	1187.068	596.575	267.237	477.277
Total	79734.614	31848.364	14448.176	8347.124	5036.401	2734.857	1460.255	1698.423
Percentage	54.9	21.9	9.9	5.7	3.5	1.9	1.0	1.2

Table No. IV-2

Total stems (in '000) by species and Ranges

Species	Name of Ranges												
	Udaipur	Parsad	Solunbar	Kuraber	Iherwada	Gogunda	Bansi	Penarwa	Jhadol	Kotra	Dhariawad	Kumbalgarh	Total
<i>Terminalia</i>													
<i>belerica</i>	8,151	2,997	12,586	-	67,301	15,824	-	137,612	111,635	119,303	6,388	10,208	492,005
<i>Anogeissus</i>													
<i>latifolia</i>	1028,432	1035,188	257,947	147,194	2964,569	1924,782	856,556	3630,275	3841,542	8197,037	2520,763	2214,080	28618,365
<i>Anogeissus</i>													
<i>pendula</i>	173,701	2,997	-	30,725	4,684	-	6,039	14,931	6,965	11,930	-	537,142	789,114
<i>Lankea cororata</i>													
<i>mandeliana</i>	880,198	916,512	359,351	130,950	1279,930	552,727	1129,678	2137,366	1428,565	2819,337	1679,208	1029,281	14393,083
<i>Adina</i>													
<i>cordifolia</i>	-	17,585	4,936	-	33,230	39,926	18,344	234,898	153,569	178,955	12,776	13,058	707,277
<i>Acacia</i>													
<i>catechu</i>	259,232	50,538	7,486	116,135	568,138	48,075	252,148	178,791	20,943	155,095	816,418	281,799	2754,798
<i>Wrightson tinctoria</i>													
<i>Terminalia</i>	730,839	539,826	230,574	129,924	370,548	1038,506	234,257	2030,086	1733,611	3154,140	375,467	1511,040	12078,826
<i>tomentosa</i>	-	-	2,550	-	365,504	-	36,461	716,268	55,768	47,721	103,722	-	1327,994
<i>Tectona</i>													
<i>grandis</i>	-	308,499	2015,322	-	1284,698	-	3602,102	306,789	631,413	381,777	7538,294	236,540	16305,434
<i>Boswellia</i>													
<i>serrata</i>	1257,383	1257,256	342,012	382,206	1569,125	504,505	228,015	623,618	727,828	2150,479	550,649	2016,328	11609,404
<i>Rhus</i>													
<i>melanoxylon</i>	66,037	113,030	406,590	37,551	1409,896	-	938,350	3149,670	526,695	2592,658	1497,216	229,267	10966,960
<i>Mitrasa</i>													
<i>tomentosa</i>	43,793	2,997	47,095	-	466,841	74,791	27,516	899,655	265,537	573,411	32,352	231,436	2663,424
Rest of spp.	2318,393	1615,335	807,544	1086,801	3389,131	1643,954	2401,189	8353,294	6225,742	8109,049	2688,008	3964,990	42601,430
Total (Di. m.)	6766,159	5862,760	4493,993	2111,466	13773,595	5843,000	9730,655	22413,253	15725,813	28490,892	17821,261	12275,177	145308,114

Table No. IV-3

Total Volume (1000 m³) by Diameter and Species

Species	Diameter classes breast height (O.B.) in cms.							
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+ Total %
<u>Acogeissus latifolia</u>	340.011	344.626	211.360	147.744	105.841	30.041	17.404	28.060 1225.087 10.4
<u>Lancea coromandelica</u>	35.118	138.319	237.609	381.028	389.013	353.658	178.273	229.233 1942.251 17.1
<u>Tectona grandis</u>	137.802	174.155	125.059	73.626	41.596	29.319	11.796	12.382 606.235 5.1
<u>Boswellia serrata</u>	21.535	65.857	181.631	364.683	598.244	561.578	491.849	1094.842 3380.319 28.6
Rest	565.973	791.376	626.864	553.409	425.853	320.218	219.763	1092.272 4595.748 38.8
Total	1100.463	1514.333	1332.593	1520.490	1560.547	1295.314	919.085	2456.789 11749.640
Percentage	9.3	12.6	11.7	12.8	13.2	10.9	8.3	21.0 100.0

Table No. IV-4

Total volume (in 1000 m³) by species & Range

Name of Range	<u>Anogeissus</u> <u>latifolia</u>	<u>Lannea</u> <u>coromandellica</u>	<u>Tectona</u> <u>grandis</u>	<u>Boswellia</u> <u>serrata</u>	Rest of species	Total of all species
Udaipur	40,688	100,401	-	243,393	172,575	557,057
Parsad	50,039	109,728	6,995	276,872	148,505	592,139
Salambar	27,726	93,893	57,626	123,348	95,461	398,054
Kurabar	8,183	48,017	-	128,330	68,846	253,376
Kherwara	130,282	114,948	41,240	231,779	434,011	952,261
Gogunda	82,212	33,969	-	91,577	147,040	374,797
Bansi	47,623	130,305	122,295	132,657	214,929	647,814
Parerwa	113,707	257,746	19,652	149,568	784,508	1325,181
Jhadol	161,061	120,987	21,421	200,276	611,282	1115,027
Kotra	286,557	436,014	12,229	1015,442	1053,024	2803,266
Dhariawad	153,097	223,515	316,781	248,105	352,330	1353,828
Kumbalgarh	123,907	192,728	7,996	538,972	513,237	1376,840
Total	1225,087	1942,251	606,235	3360,319	4595,748	11749,640

4.1.3 Total growing stock of Bamboos

The total growing stock of bamboo in the while division by clump sizes, quality, age, condition etc. is given below in Table Nos. IV-5 to IV-8.

Table No. IV-5

Total No. of clumps by quality & size classes

Quality	Size classes			Total
	Size 1	Size 2	Size 3	
I	7788567	4719743	1732358	14240668
II	1568762	728079	276212	2573053
Total	9357329	5447822	2008570	16813721

Table No. IV-6

Total number of culms-Sound, Damaged and Dry-rotten (in '000) by quality and size classes

Quality	Size class	Sound S	Damaged D	Dry-rotten DR	Total
I	1	38008	25235	27416	90659
	2	47103	22277	35398	104778
	3	26782	12629	19160	58571
II	1	5240	8785	10181	24206
	2	4696	5788	6196	16680
	3	2019	1364	1693	5076
Total		123848	76078	100044	299970

Table No. IV-7

Total number of one season, two season and three and more seasons old culms (in '000) by quality and size class

Quality	Size class	One season	Two season	Three season & more	Total
I	1	10515	22509	57635	90659
	2	12271	21664	70843	104778
	3	7432	9528	41611	58571
II	1	1945	5820	16441	24206
	2	1281	3750	11649	16680
	3	621	467	3988	5076
Total		34065	63738	202167	299970

Presuming that 4 damaged culms = 1 sound culm and 4 dry-rotten culms = 1 sound culm, the total growing stock of bamboo in terms of standard bamboos (length 4.572 mt.) has been calculated. Same is given in Table No. IV-8.

Table No. IV-8

Total growing stock of bamboo (in '000 standard bamboo)

Quality	Sizes			Total
	Size-1	Size-2	Size-3	
I	26861	39158	22940	88959
II	3733	3415	1436	8584
Total	30594	42573	24376	97543

4.2 GROWTH RATE

Ring formation in most of the species except teak occurring in the survey area is not very distinct. Therefore, growth data was collected only for teak. The age-diameter relationship for teak is given in Table No. IV-9. Age-diameter and age-height curves for teak and diameter-height curves for other species are given in appendix.

Table No. IV-9

Age-diameter relationship for Teak

Breast height diameter (O.B.) in cms.	Age (years)
5	8
10	16
15	27
20	42
25	60
30	83

4.3 YIELD (ANNUAL CUT)

The annual cut depends upon growing stock rotation, rate of growth, management practices and many other important considerations. For precise estimation of annual yield, a detailed and comprehensive information of crop, its composition, age, density, soil, topography etc. for each management unit i.e. block/compartment is necessary, which is beyond the scope of this study. Therefore, the estimate of annual cut given in the following paragraphs, is indicative only.

At present almost all the forests except small area under steep slopes are worked under "Coppice with Standards" system, with 20 years conversion period for Teak forests and 40 years for others. Sal and Godal are however, worked under selection system with 10 years felling cycle. The exploitation diameter is 30 cms. Under the present conditions the coppice with standards system does not suit to the forests due to following reasons:-

1. The forests are extremely irregular in composition, density and growth and a few standards left do not afford sufficient protection to soil.
2. Except a few standards, all the trees are felled resulting into very heavy sacrifice of immature crop.
3. Requisite number of standards of commercially important spp. are not available. For example, there are only 6 stems per ha. of teak above 20 cm. as against the requirement of 40-50 stems/ha.
4. The standards are prone to illicit felling.
5. Even if the standards are properly protected they will develop hollowness by the time they become due for felling in second rotation.

In order to ensure conservation of forests and eventually obtaining full value of increment a modified system called "Coppice with reserves" may be more suitable. Under this system all well developed immature poles of valuable species should be retained as reserves after removing less valuable or other trees interfering with their growth. Besides these well grown trees and poles of fruit bearing species can also be retained. A perusal of Table No. 3 in appendix will show that natural regeneration is almost absent. Lack of sufficient moisture and excessive biotic interference are perhaps the most important factors responsible for this state of affairs. Further, Teak (*Tectona grandis*) Dhawra (*Anogeissus latifolia*) develop hollowness at very early age (more than 50% of the trees become hollow beyond 20 cm. dia.). May be that the site may not support bigger size crop but it is a common experience that successive coppicing, encourages hollowness at an early age. Therefore, serious efforts should be made to supplement the coppice crop with artificial regeneration. Effective closure of the coupe and appropriate soil conservation practices like contour trenching, check damming etc. two years in advance of felling is likely to be very beneficial and may encourage natural regeneration. This will also help in establishing the artificial regeneration to be done immediately after the felling.

Under the recommended silvicultural system i.e. coppice with reserve system the annual yield will naturally depend upon the extent of reservation. It will be seen from Table No. IV-3 that approximately 25% of the growing stock of teak at Dhawra is under 10 cm. diameter and another 30% is in 10-15 cm. diameter class. On the other hand in case of Sala and Godal only 5% of the growing stock is under 15 cm. diameter while for 15 cm. Keeping in view these variations in the proportion of the growing stock in pole stage, it is presumed that 30% of the growing stock of teak and dhawra, 5% of Salar and godal and 20% of rest of species may have to be retained as reserves. Basing on these assumptions and with a conversion period of 40 years, the estimated annual yield would be as given below :-

1. Teak	$= 606235 \times \frac{70}{100} \times \frac{1}{40} = 10609 \text{ m}^3$
2. Dhawra	$= 1225087 \times \frac{70}{100} \times \frac{1}{40} = 21439 \text{ m}^3$
3. Salar	$= 3380319 \times \frac{95}{100} \times \frac{1}{40} = 80283 \text{ m}^3$
4. Godal	$= 1942251 \times \frac{95}{100} \times \frac{1}{40} = 46128 \text{ m}^3$
5. Rest of species	$= 4595748 \times \frac{80}{100} \times \frac{1}{40} = 91915 \text{ m}^3$
Total yield	$= 250374 \text{ m}^3$

4.3.1 annual cut available in different utility classes

Available annual cut has been estimated by different utility classes also and same is given in Table No. IV-10.

Miscellaneous species 30% of the growing stock is below

Table No. IV-10

Annual cut available in different utility classes.

S.No.	Utility class	Species/Group of species			Total of all spp. m ³	Number of pieces
		<u>Roswellia serrata</u> m ³	<u>Lannea coromandelica</u> m ³	All other species		
1.	<u>Lath</u>	-	-	7809.92	7809.92	42677
2.	<u>Path</u>	-	-	2231.41	2231.41	28246
3.	<u>Balewan</u>	-	-	5082.65	5082.65	84711
4.	<u>Ballies-I</u>	-	-	1487.60	1487.60	40205
5.	<u>Ballies-II</u>	-	-	2355.37	2355.37	98140
6.	<u>Ballies-III</u>	-	-	371.90	371.90	19574
7.	<u>Ballies-IV</u>	-	-	2603.31	2603.31	218942
8.	<u>Poles-I</u>	-	-	247.93	247.93	30991
9.	<u>Poles-II</u>	-	-	1115.70	1115.70	159386
10.	<u>Poles-III</u>	-	-	371.90	371.90	74380
11.	<u>Gatvey-I</u>	-	-	867.77	867.77	173554
12.	<u>Gatvey-II</u>	-	-	2231.40	2231.40	159386
13.	<u>Gatvey-III</u>	-	-	1859.50	1859.50	109382
14.	<u>Gatvey-IV</u>	-	-	8677.69	8677.69	289256
15.	<u>Gatvey-V</u>	-	-	7190.09	7190.09	138271
16.	<u>Gatvey-VI</u>	-	-	31487.62	31487.62	269125
17.	Packing cases	-	13748.59	-	13748.59	371583
18.	Match splints	53956.22	-	-	53956.22	352655
19.	Plywood	-	19805.66	-	19805.66	137539
20.	Fuelwood	29145.99	16584.84	46983.49	92714.32	515079
21.	No utility	5540.15	3701.54	10289.26	19530.95	4882737

4.3.2 Yield of bamboo

In calculating the annual cut of bamboo, it has to be remembered that all the one year old culms are to be retained. In addition, the older culms equal to twice the number of one year old culms subject to a minimum of eight per clump should be retained. Since the average number of one year old culms per clump is less than four, about eight sound culms per clump over one year age are to be retained. A detailed examination of Tables No. III-16 and III-17 will show that the difference of sound culms and one season old culms is less than 4 (mid point of 0 and 8) culms per clump for quality I

size class 1, and quality II, size class 1 & 2. Therefore, no yield is expected from these quality/size classes. A further scrutiny of these tables will show that following yield can be expected from different quality/size classes.

1. approximately $\frac{1}{4}$ of the clumps of quality I size 2 are expected to yield about 3 culms per clump.
2. All the clumps in quality I size 3 are expected to give at least 3 culms per clump. In addition, about $\frac{1}{4}$ of the clumps may give about 5.5 culms per clump.
- Approximately $\frac{1}{4}$ of the clumps of quality II, size class 3, are expected to give at least one culm per clump.

In addition to removals, as suggested under item 1, 2 and 3 above, all the dead, dry and damaged culms should be removed in one cutting cycle of four years so as to ensure better hygienic conditions for proper growth in the clumps. Keeping in view above observations following annual yield of bamboo is suggested.

- | | | |
|-----------------|---|---|
| 1. Dry bamboo | - | 6.21 million standard bamboo
or 12400 M.T. |
| 2. Green bamboo | - | 8.20 million standard bamboo
or 16400 M.T. |

It may be noted that total annual recruitment is about 34 million culms which is equal to 20 million standard bamboo or 40,000 M.T. Under normal conditions the annual yield should be equal to annual recruitment. Thus the annual yield under normal conditions should have been about 40,000 M.T. But the conditions are far from normal about 60% of the clumps contain less than 8 sound culms per clump required for retention. Therefore, a considerable low yield of green culms is suggested so as to build up the growing stock to required level. After first cutting cycle the yield of dry bamboo will fall to negligible amount. But in the meantime, the growing stock of green bamboo will increase and consequently the yield of green bamboo will increase substantially. In fact, if all the dead, dry, damaged and half cut culms are removed in first cycle, the annual recruitment will increase considerably and the yield may exceed 40,000 M.T. during second cutting cycle. It will not be out of place to mention that the survey area has a great potential for bamboo and if properly protected and managed scientifically, the annual yield may even exceed 50,000 M.T.

CHAPTER - V

5. INDUSTRIAL POTENTIAL

5.1 SUPPLY AND DEMAND ANALYSIS

Supply and Demand study was undertaken in order to estimate the availability of timber for forest based industries. The results of this study are summarised below. For details of methodology adopted for this study, Part II of Volume II of the Report may be referred to.

5.1.2 Production of Wood.

The figures of wood production have been collected for the forests under the control of Forest Department, revenue forests and private forests. Wood removal from Government forests is entirely through State Agency (i.e. State Trading Division). Summary of wood and bamboo production is given below in Table No. V-1.

Table No. V-1

Recorded production of wood and bamboo during 1975-76

Source/Agency	Timber (m ³)	Firewood (tonnes)	Charcoal (tonnes)	Bamboo (Standard bamboo Nos.)	Others
A. From Govt. forests					
1. Through contractors	(218.038)	(192.4)	730.3	(312994)	-
2. Through Govt. agency.	1554.0 (1926.6)	5097.2 (10418.4)	4551.2 (4503.8)	2764429 (6441817)	1075.5 (979.8)
3. Through Right-holders & concessionists	3201.02 (6507.96)	-	-	26750 (95475)	-
Total from Govt. forests.	4755.02 (8652.598)	5097.2 (10610.8)	4551.2 (5234.1)	2791179 (6850286)	1075.5 (979.0)
tonnes					
Khirmi wood					
B. From Private lands/forests	1891.6 (3169.3)	752.0 (840.8)	917.0 (1177.6)	30200 (7550)	
Grand Total (A + B)	6646.62 (11821.898)	5849.2 (11451.6)	5468.2 (6411.7)	2821379 (6857836)	1075.5 (979.8)
tonnes					
Khirmi wood					

Note :- Figures in brackets give the annual average for the year from 1972-73 to 1975-76.

5.1.3 Import-Export of wood and bamboos:

The area towards west of survey area is devoid of any forests and, therefore, a considerable quantity of wood and bamboos are exported to this area. Bamboos are also exported to Punjab, Haryana and other parts of the country.

Since all the wood harvesting operations and disposals are done by the State agency (State Trading Circle) full particulars of export by rail and road are readily available with the State Trading Circle. The export figures for the year 1975-76 are given below (figures in brackets give the annual average from 1972-73 to 1975-76).

1. Teak (Sagwan) timber	= Nil (18.886 m ³)
2. Teak (Small size) timber	= 205.375 m ³ (171.118 m ³)
3. Misc. (small size) timber	= 197.304 m ³ (472.004 m ³)
4. Salar-Godal timber	= 88.726 m ³ (143.257 m ³)
5. Charcoal	= 702.6 tonnes (914.1 tonnes)
6. Firewood	= 339.1 tonnes (757.4 tonnes)
7. Bamboos	= 2523554 standard bamboos (2552277).

Although a large quantity of wood finds its way to the survey area from the adjoining areas of Madhya Pradesh, but no reliable information on imports by road could be available. However, the figures of imports by rail were available from Railways. The same for the year 1975-76 are given below :-

Timber (sawn sizes)	= 1134.0 tonnes
Timber (round logs)	= 521.90 "
Timber (Gir sleepers)	= 54.90 "
Timber (Mango planks)	= 18.30 "

5.1.4 Consumption of wood by industries

Wood is processed by saw mills for using it in building construction, furniture making etc. Survey of saw mills was carried out to estimate the total out-turn of sawn timber during 1975-76. There are 54 saw mill premises who in all work 57 vertical band saws and 8 horizontal band saws. There are only 8 saw mills each with one vertical and one horizontal band saw. Only 28 saw mills operate full time and the rest divert their fixed machines for paddy hulling and other allied purposes. In all they engage about 158 labourers mostly skilled.

The measurement of sawn wood in saw mills is mostly recorded in terms of sawn surface and not in terms of cubic contents. The thickness of sawn pieces is also not recorded. Therefore, it could not be possible to estimate the sawn out-turn from these saw mills.

There are hardly any wood based industries with in the catchment, except the toy making industry. The supply of khimi wood to the toy making industry is made by Forest Department at concessional rates. Some supplies are also made to M/s. Gujrat Paper Mill, Ahmedabad. The supply of wood and other forest produce to industries during 1975-76 is given below:-

1) M/s Gujrat Paper Mill -a) Bamboo-waste-66 tonnes
Ahmedabad. (171 tonnes)

b) Salar-Godal waste
250 tonnes.
(102.6 tonnes)

2) M/s DCM Kota Charcoal - 2119.7 tonnes
(1101.7 ")

3) Toy making Industry Khimi Wood - 1075.5 "
(979.6 tonnes)

(Figures in brackets give the annual average from 1972-73 to 1975-76).

Supplies made to various Government Departments is given below in Table No. V-2.

Table No. V-2

Supply of wood and other forest produce to Govt. Departments during 1975-76. (Figures in brackets give the annual average from 1972-73 to 1975-76).

Name of Deptt.	Small timber (m ³)	Firewood (tonnes)	Charcoal (tonnes)	Bamboo (No. of standard bamboos)
1. Public Works Deptt. including C.P.W.D.	299.60 (156.80)	2994.0 (1288.8)	- (5.00)	1500 (375)
2. Schools & Colleges.	-	85.0 (28.2)	0.04 (4.21)	-
3. Irrigation	- (225.50)	-	-	-
4. Health Deptt.	-	29.4 (174.8)	9.8 (4.6)	-
5. Others	-	485.9 (222.1)	0.62 (0.21)	-
Total	299.60 (382.30)	3594.3 (1713.9)	10.46 (14.02)	1500 (375)

5.1.5 Consumption of wood by local population

A low intensity survey was done to estimate the wood consumption by local people for -

- i) building construction and repairs;
- ii) agricultural implements;
- iii) firewood.

There are 3056 villages in the survey area. These villages were divided into two categories depending upon their distances from the nearest forest. Out of the total 3056 villages, 1305 villages are within 5 kms. from the nearest forest and 1751 villages are beyond 5 kms. From these two categories 14 and 16 villages respectively were randomly selected for sampling. 10% of the total house-hold from each of these randomly selected villages were selected finally for collection of information for rural areas. The selection of house-holds was done subjectively so as to incorporate different types and sizes of house-holds. In urban areas 10% of the new houses constructed during 1976 in three of the six towns selected randomly were visited for collecting information on domestic consumption of wood for building construction, repairs and fuelwood in urban areas. For details of survey, Part II of Volume II may be referred to. The results of this study are summarised below:-

Table No. V-3

Per household consumption by local population

Description of the item	Particulars of rural area			Particulars of urban area
	For villages within 5 kms.	For villages beyond 5 kms.	Mean	
1.	2.	3.	4.	5.
1. Total No. of houses	169	119	-	57
2. Total No. of persons ✓	994	759	-	419
3. Average plinth area per house-hold.	70.58 m ²	47.74 m ²	61.14 m ²	66.62 m ²
✓ 4. Consumption of timber (w.r.e.) per household for construction of houses.	3.098 m ³	1.541 m ³	2.455 m ³	1.687 m ³
5. Consumption of bamboo (Nos. of standard bamboos) per household for building construction.	204	204	204	10.5
✓ 6. Annual consumption of firewood per household (tonnes)	3.939	3.210	3.638	1.205 (tonnes)

Table contd. next page

1.	2.	3.	4.	5.
✓ 7. Average consumption of wood (W.R.O.) per household for agricultural implements (plough)	0.166 m ³	0.186 m ³	0.174 m ³	-
8. Average number of agricultural implements (plough) per household.	0.964	0.924	0.947	-
9. Average consumption of wood (W.R.O.) per household for bullock carts.	0.028 m ³	0.196 m ³	0.097 m ³	-
10. Average number of bullock carts per household.	0.041	0.286	0.142	-
11. Average consumption of wood (W.R.O.) per household for persian wheel.	0.319 m ³	0.093 m ³	0.226 m ³	-
12. Average number of persian wheels per households.	0.178	0.269	0.215	-

The average annual increase in population for Udaipur district during 1961 to 1971 is 2.94% and 3.24% respectively; for rural and urban areas. Assuming the same percentages for increase in house-holds, the total number of households in 1976 (base year) has been calculated and same is given below:

	<u>Rural</u>	<u>Urban</u>	<u>Total</u>
Number of household in 1971.	291333	43453	334786
Average annual increase in households.	8565	1408	9973
Number of households in 1976.	334158	50493	384651

Basing on the following assumptions which have been arrived at by local queries, the annual requirements of timber and bamboos in 1976 for domestic purposes has been estimated.

Assumptions:

- 1) 10% of timber requirement for new house construction is required for repair of house every 10th year in rural areas.

- 2) 5% of timber requirement for new house construction is required for repair of house every 10th year in urban areas.
- 3) The life of plough, bullock cart and persian wheel is 2, 10 and 10 years respectively.
- 4) 10% of the timber requirement for new agricultural implements (including bullock-carts and persian wheels) is required for repairs every year.
- 5) 10% of the bamboos are replaced every alternate year.

Expected annual requirement of wood and bamboos for domestic consumption during 1976.

- | | |
|---|----------------------------------|
| 1. Requirement of timber for construction and repair of houses (in w.r.e.) | = 32032 m ³ |
| 2. Requirement of timber for agricultural implements (including bullock carts & persian wheels) and their repairs.(w.r.e.) | = 56473 m ³ . |
| 3. Requirement of wood for consumption as firewood- (w.r.e.) | = 1,914,766 m ³ |
| Total | = <u>2,003,271 m³</u> |
| 4. Requirements of Bamboos for house construction & repairs. | = 51,97,000 standard bamboos |

The survey has further revealed that quite a substantial quantity of wood used for above purposes comes from the private sources i.e. from the trees standing in the fields of the farmers. On an average approximate 25%, 75% and 45% of the requirement of wood for building construction, agricultural implements and firewood respectively comes from the trees standing over private lands. It has been observed that almost all the important species found in the area are used for one or the other purposes mentioned above. However, salar and godal for the time being are not used for any of these purposes to any appreciable extent.

5.1.6 Fore-cast of future demand:

The future demand of a commodity depends upon various factors such as growth in population, change in income price trend of various consumer goods, changes in technology, availability of substitutes, literacy, consumer preference etc. In the present study, only two factors i.e. population growth and change in income have been taken into consideration for estimating the future demand of wood.

5.1.7 Population estimates

The population estimates for the survey year (1976) and target years (1980 and 1985) have been obtained by adopting past compound rates of growth for rural and urban areas separately. Since there is wide variation in growth rates during 1951-61 and 1961-71, reasonable growth rates i.e. 0.5% upto 1976 and 1% thereafter for rural areas 3.1%/adopted for arriving at population estimates. The population estimates are as under :-

	<u>Rural</u>	<u>Urban</u>	<u>Total</u>
Upto 1976 and 2.5% thereafter for urban areas, have been	1976 15,46,000	2,57,000	18,03,000
	1980 16,49,000	2,89,500	19,38,500
	1985 17,33,000	3,13,500	20,46,500

5.1.8 Income estimates

As with the population growth there is wide range in income growth rates also. A uniform rate of growth (5%) is adopted for estimating the per capita income in different years. Per capita income during 1973-74 is 308. The estimates of per capita income are as under :

<u>Year</u>	<u>Per capita income</u>
1973-74	308/-
1975-76	320/-
1979-80	410/-
1984-85	515/-

5.1.9 Demand fore-cast of wood consumption

The demand of timber for agricultural implements and also for firewood is comparatively inelastic and hence future demand of wood for these purposes has been taken as proportional to population. The future demand of wood for building construction and repairs, however, is estimated by the following formula:-

$$\log \frac{Y'}{Y} = 0.4343 \times I.E. \left(1 - \frac{x}{x'}\right)$$

Y' - Per capita annual consumption of wood in the target year.

Y - Per capita annual consumption in base year.

x - Per capita income in base year.

x' - Per capita income in target year.

$I.E.$ - Income elasticity of consumption of wood for housing = 0.8

Since consumption of wood by industries and various Government Departments is very small as compared to the consumption by local people for domestic purpose, no estimate of future demand by industries and Government Departments is made. The abstract of estimated requirement of wood and bamboos in different years is given below :-

Table No. V-4

Estimated requirement of wood and bamboo in different years

Particulars of consumption	1976	1980	1985
1. Wood for house construction and repairs (w.r.e.)	32032 m ³	34893 m ³	38883 m ³
2. Wood for agricultural implements (including bullock-carts & persian wheels) and their repairs (w.r.e.)	56473 m ³	60200 m ³	63250 m ³
3. Firewood (w.r.e.)	1914766 m ³	2058373 m ³	2173259 m ³
Total :	2003271 m ³	2153466 m ³	2275392 m ³
4. Bamboos for house and cattle shed construction and repairs.	5197000 nos.	5586200 nos.	5897500 nos.

5.2 INDUSTRIAL POTENTIAL

5.2.1. In order to ensure sustained supply of raw material for wood based industries, it is necessary to estimate the present level of wood consumption by local population and the existing wood based industries and to make realistic projections of future demand. The quantity of material required by local population and the existing industries should be set apart while planning for expansion of industrial activity. The Table No. V-5 gives the present and projected demand of the different woods by local peoples and the potential annual cut which gives idea of availability of raw material for wood based industries.

Table No. V.5

Estimated surplus wood and bamboo in different years

Year	Potential annual cut		Requirement for domestic purposes		Surplus available	
	timber (000 m ³)	bamboos (000 tonnes)	timber (000 m ³)	bamboos (000 tonnes)	timber (000 m ³)	bamboos (000 tonnes)
1976	250.374	28.800	2003.271	10.394	(-)1752.897	18.406
1980	250.374	28.800	2153.466	11.172	(-)1903.092	17.628
1985	250.374	28.800	2275.392	11.795	(-)2025.018	17.005

5.2.2 It would be clear from the above table that the area is terribly short of timber although there is considerable quantity of surplus bamboo which may be used for industrial purposes. One interesting feature of utilisation of existing timber is that although there is acute shortage of wood in the area, yet salar and godal, which account for approximate 45% of growing stock and 50% of the potential yield, are not used for any purpose to any appreciable extent. Therefore, keeping in view the conventional uses, entire potential annual cut of Salar-Godal may be taken as surplus available for industries.

Thus the quantity of wood likely to be available for industrial purposes would be as under :-

Salar	= 80283 m ³
Godal	= 46122 m ³
Total	= 126411 m ³

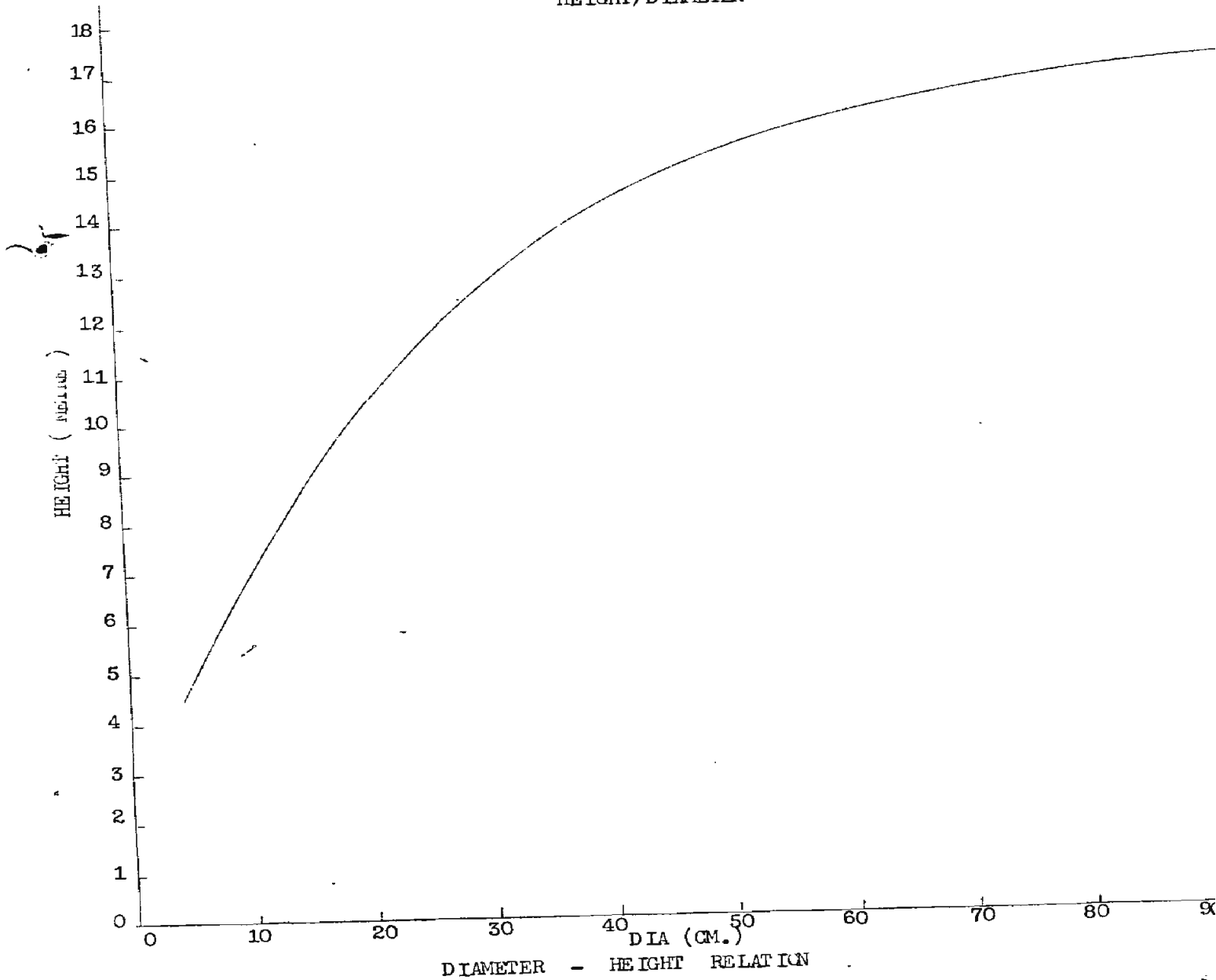
Bamboos = 17000 M.T.

It may, thus, be noted that on one hand the survey area is deficit in conventional timber and is unable to meet the demand of local people for domestic purposes, but on the other, approximately 1,26,000 m³ Salar-Godal wood is surplus to local requirement and may be available for Wood Based Industries.

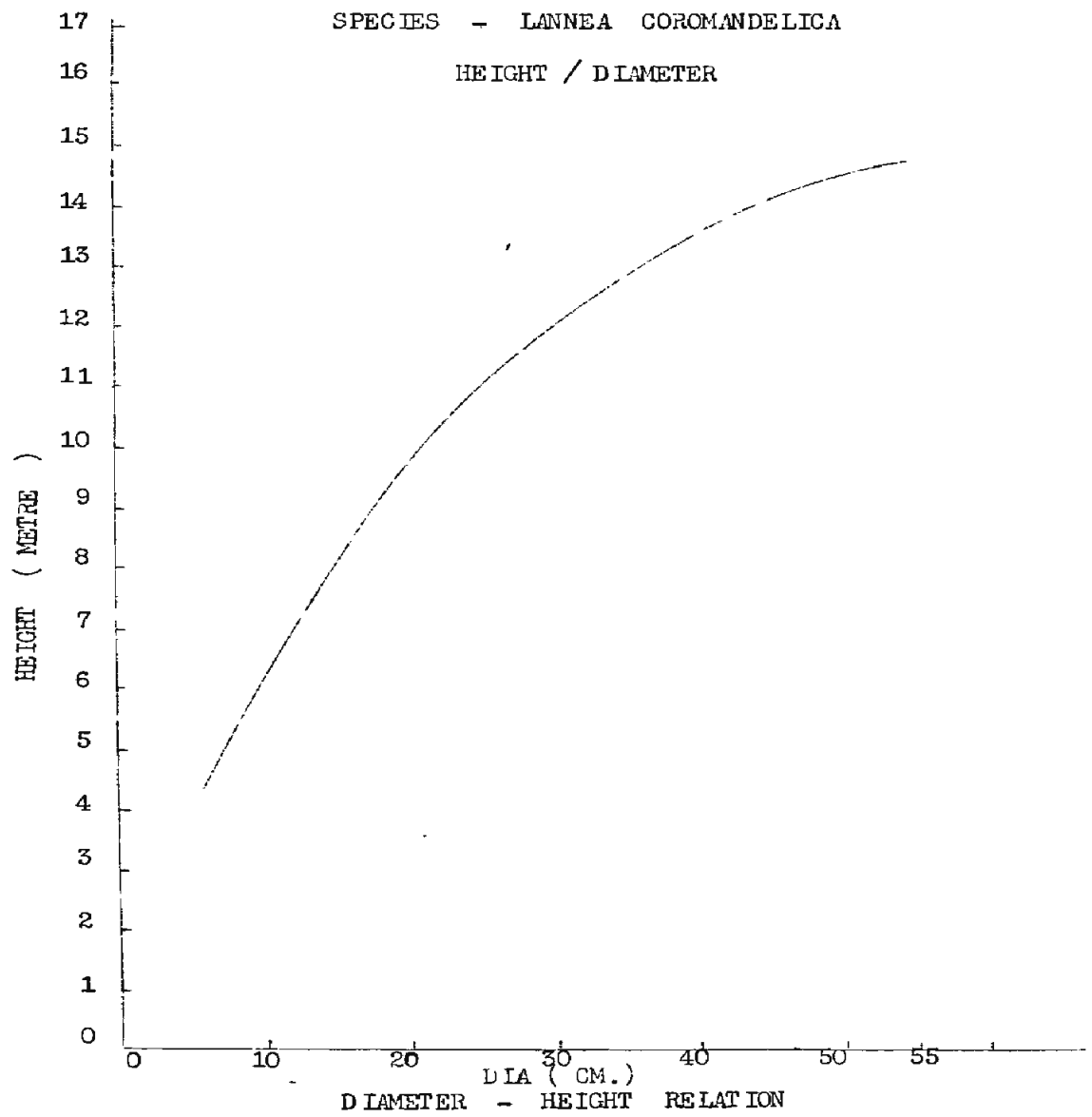
DIA (CM)	HEIGHT (M)
5	4.44
10	6.78
15	8.52
20	10.12
25	11.41
30	12.59
35	13.53
40	14.30
45	14.80
50	15.28
55	15.65
60	16.00
65	16.23
70	16.46
75	16.60
80	16.78
85	16.90
90	17.00
95	17.08

SPECIES - BOSWELLIA SERRATA

HEIGHT/DIAMETER



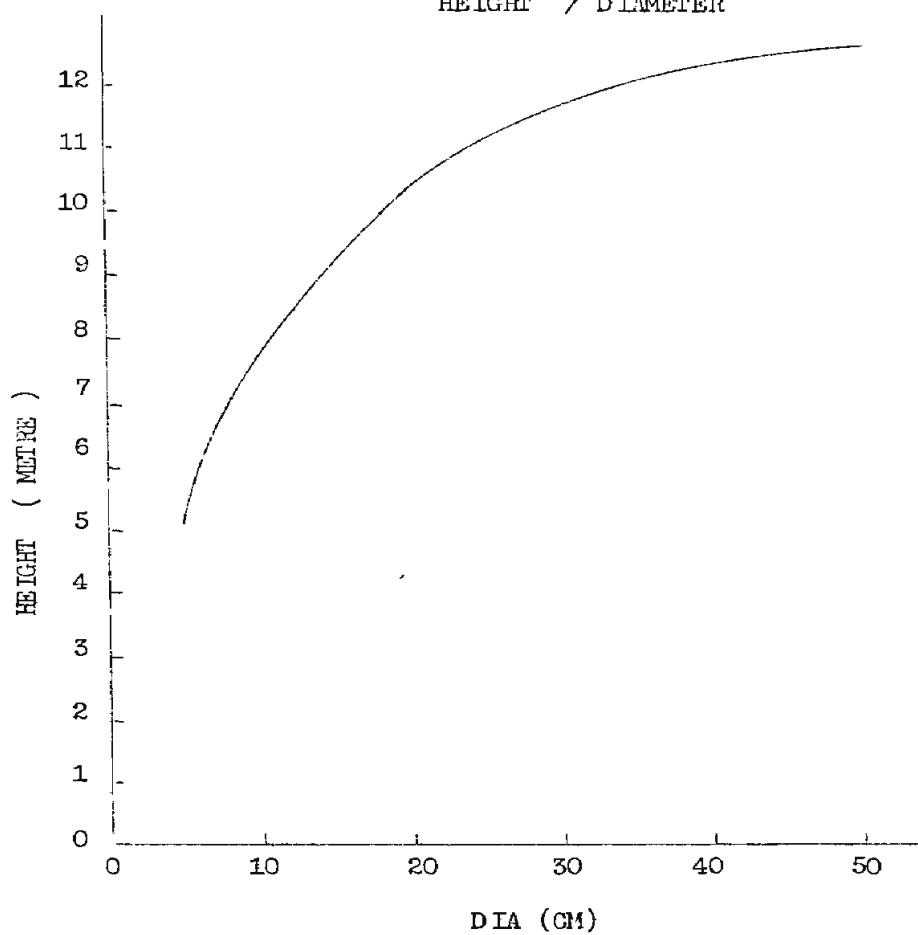
DIA (CM)	5	10	15	20	25	30	35	40	45	50	55
HEIGHT (M)	4.20	6.40	8.35	10.00	11.32	12.31	13.04	13.61	14.08	14.45	14.80



DIA (CM)	5	10	15	20	25	30	35	40	45	50
HEIGHT (M)	5.18	7.70	9.22	10.30	11.08	11.60	11.97	12.21	12.38	12.53

SPECIES - ANOGLOSSUS LATIFOLIA

HEIGHT / DIAMETER



DIAMETER - HEIGHT RELATION

HEIGHT (M)

DIA. - HEIGHT RELATION
SPECIES - REST OF SPECIES
HEIGHT/DIA.

DIA(CM)	HT.(M)
5	4.55
10	6.18
15	7.46
20	8.65
25	9.70
30	10.73
35	11.68
40	12.60
45	13.45
50	14.22
55	14.89
60	15.49
65	15.99
70	16.38
75	16.72
80	17.00
85	17.22
90	17.40
95	17.56
100	17.70
105	17.80
110	17.90
115	17.99

10

20

30

40

50

DIA. (CM)

60

70

80

90

100

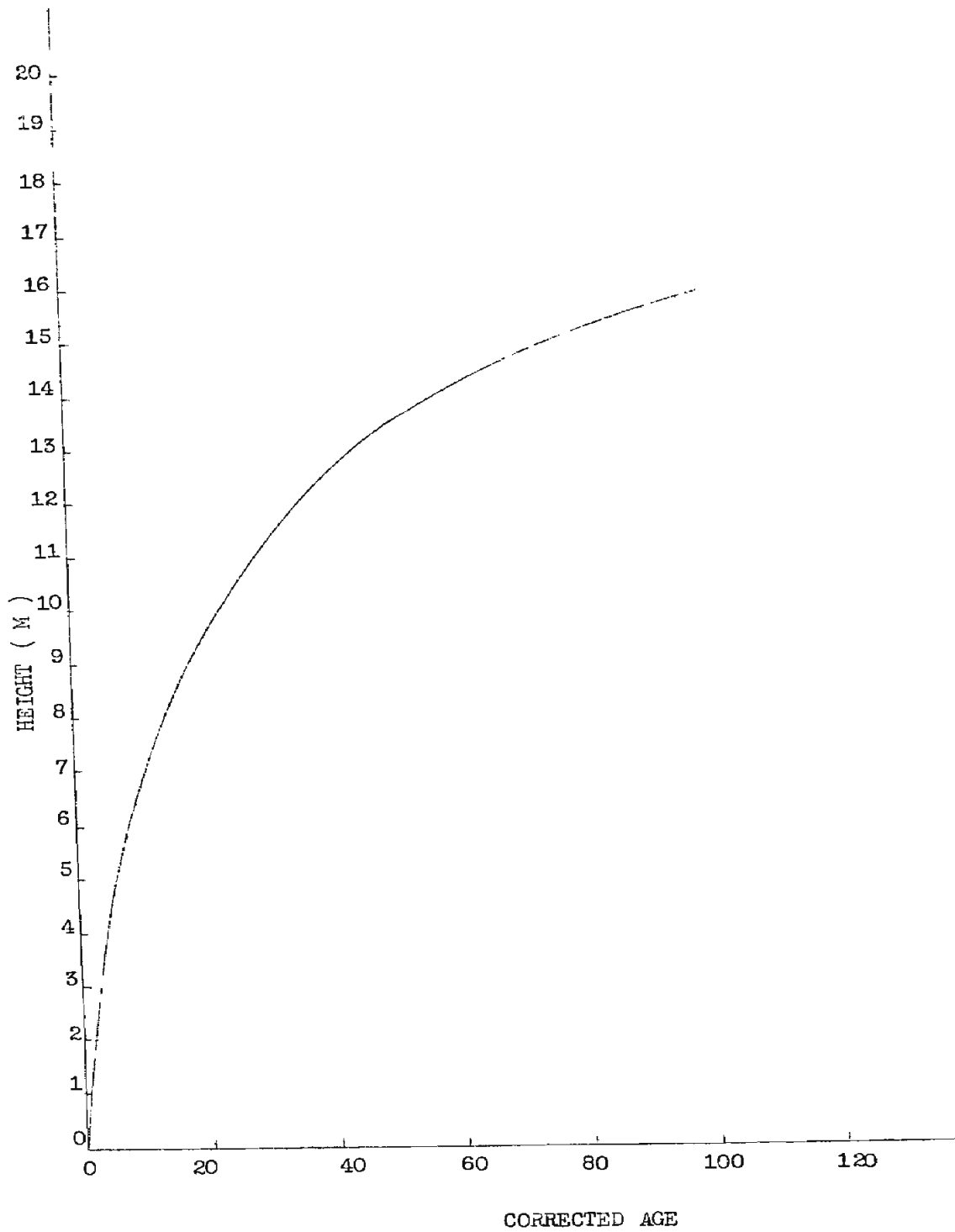
110

115

HEIGHT -- AGE -- RELATION

TEAK
HEIGHT / AGE

HEIGHT (M)	5	6	7	8	9	10	11	12	13	14	15	16
AGE (YEARS)	6	7	9	13	17	22	27	34	42	54	70	96

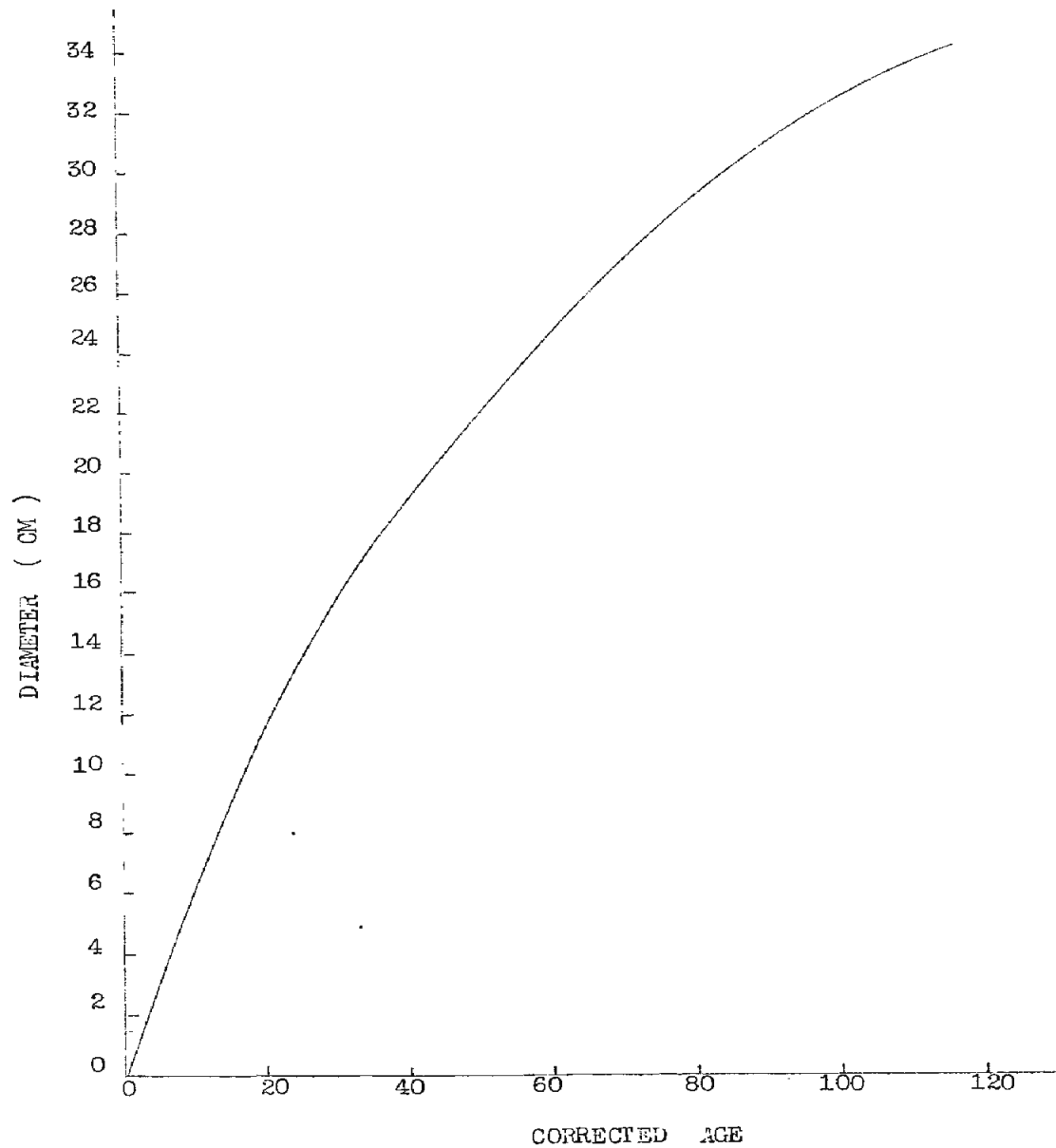


DIAMETER - AGE - RELATION

TEAK

DIAMETER / AGE

DIAMETER (CM)	5	10	15	20	25	30
AGE (YEARS)	8	16	27	42	60	83

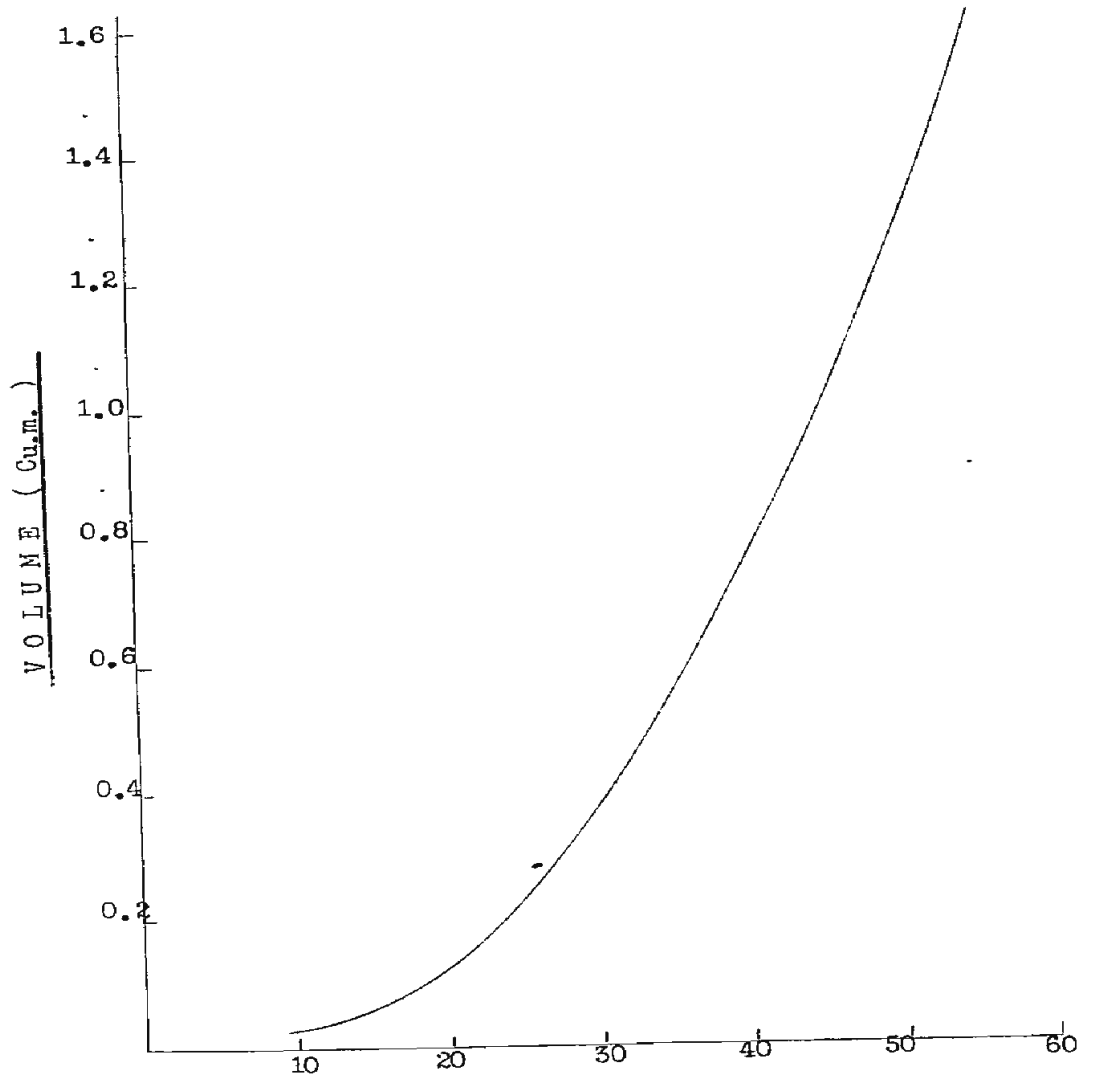


RAJASTHAN SURVEY

Species - TECTONAGRANDIS

DIAMETER - VOLUME RELATION.

Diameter (Cm.)	Vol. (Cu.m.)
10.0	.122
12.5	.638
15.0	.063
17.5	.100
20.0	.148
22.5	.200
25.0	.268
27.5	.344
30.0	.334
32.5	.412
35.0	.500
37.5	.604
40.0	.712
42.5	.830
45.0	.956
47.5	1.089
50.0	1.235
52.5	1.390
55.0	1.555



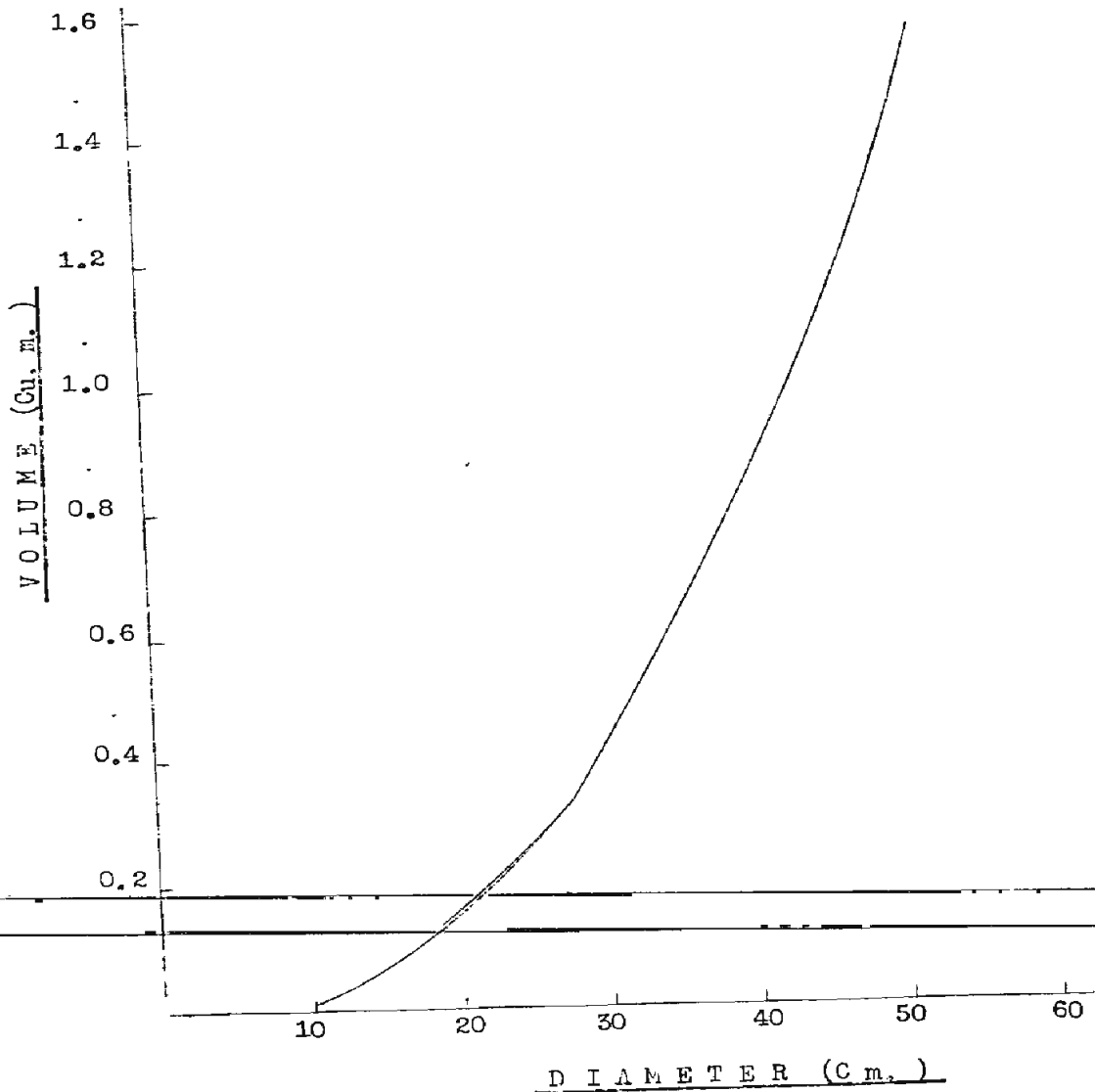
D-I-A-M-E-T-E-R—(C.m.)

RAJASTHAN SURVEY

Species - LAMNEA COROMANDELICA.

DIAMETER - VOLUME RELATION.

DIA (C.M.)	VOL. (Cu.m.)
10.0	.041
12.5	.066
15.0	.098
17.5	.133
20.0	.178
22.5	.226
25.0	.283
27.5	.343
30.0	.407
32.5	.479
35.0	.556
37.5	.640
40.0	.724
42.5	.818
45.0	.922
47.5	1.024
50.0	1.138
52.5	1.255

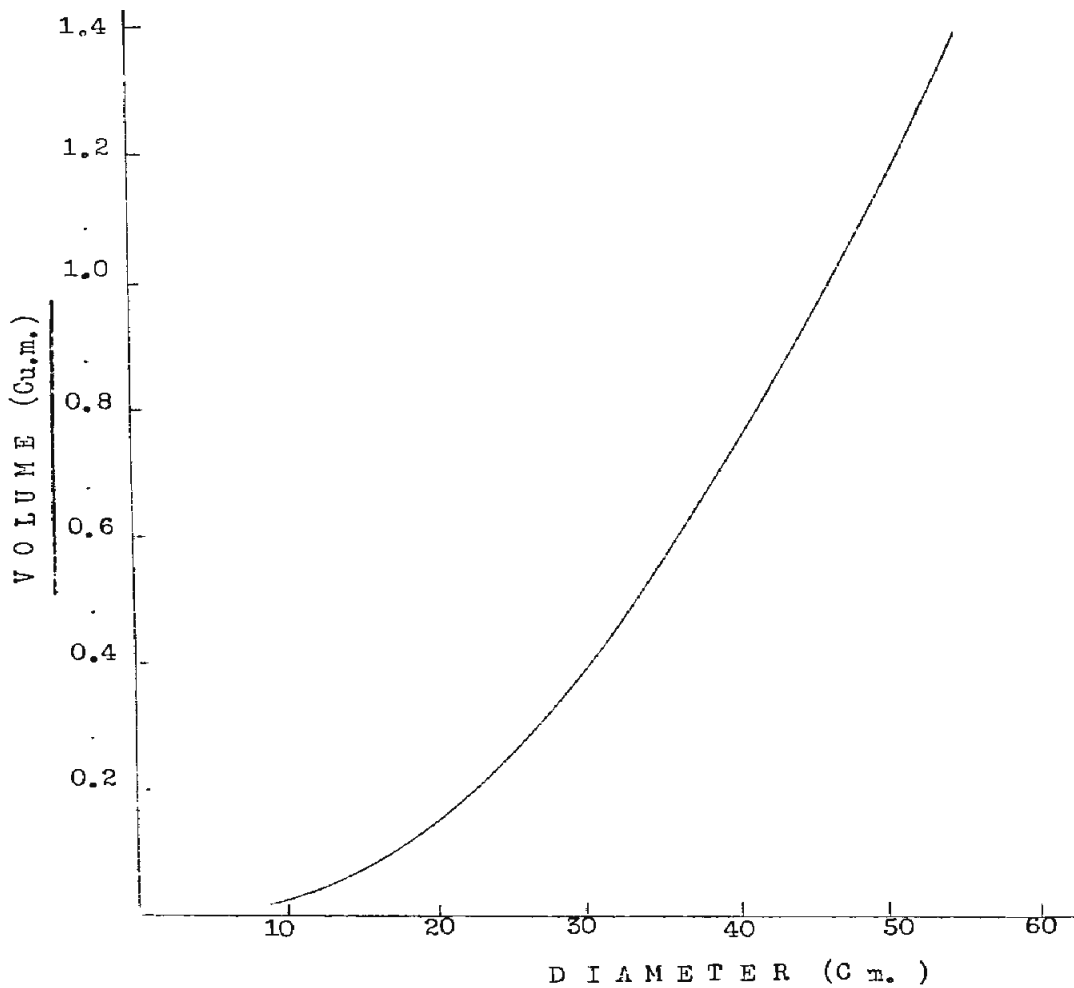


RAJASTHAN SURVEY

Species - *ANOGEISSUS LATIFOLIA*

DIAMETER - VOLUME RELATION

DIA (C.M.)	VOL. (Cu.m.)
10.0	.043
12.5	.057
15.0	.087
17.5	.093
20.0	.127
22.5	.169
25.0	.221
27.5	.227
30.0	.344
32.5	.414
35.0	.494
37.5	.584
40.0	.684
42.5	.786
45.0	.898
47.5	1.022
50.0	1.157
52.5	1.296
55.0	1.453

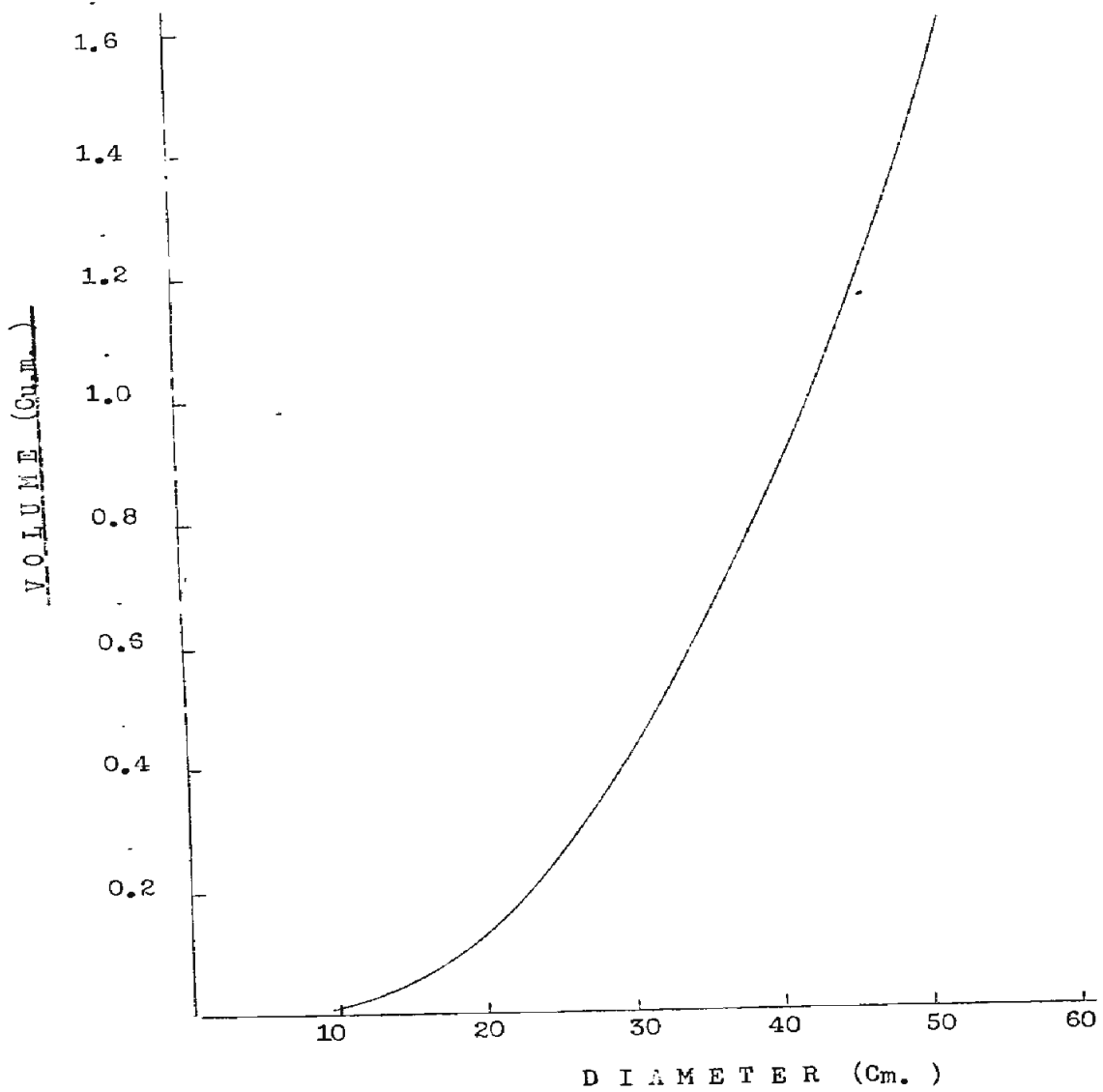


RAJASTHAN SURVLY

Species - BOSWELLIA SERRATA.

D I L I M E T E R - V O L U M E R E L A T I O N

D I L I M E T E R (Cm.)	V O L U M E (Cu.m.)
10.0	.036
12.5	.048
15.0	.069
17.5	.102
20.0	.142
22.5	.190
25.0	.245
27.5	.306
30.0	.377
32.5	.456
35.0	.542
37.5	.639
40.0	.745
42.5	.858
45.0	.977
47.5	1.106
50.0	1.252
52.5	1.394
55.0	

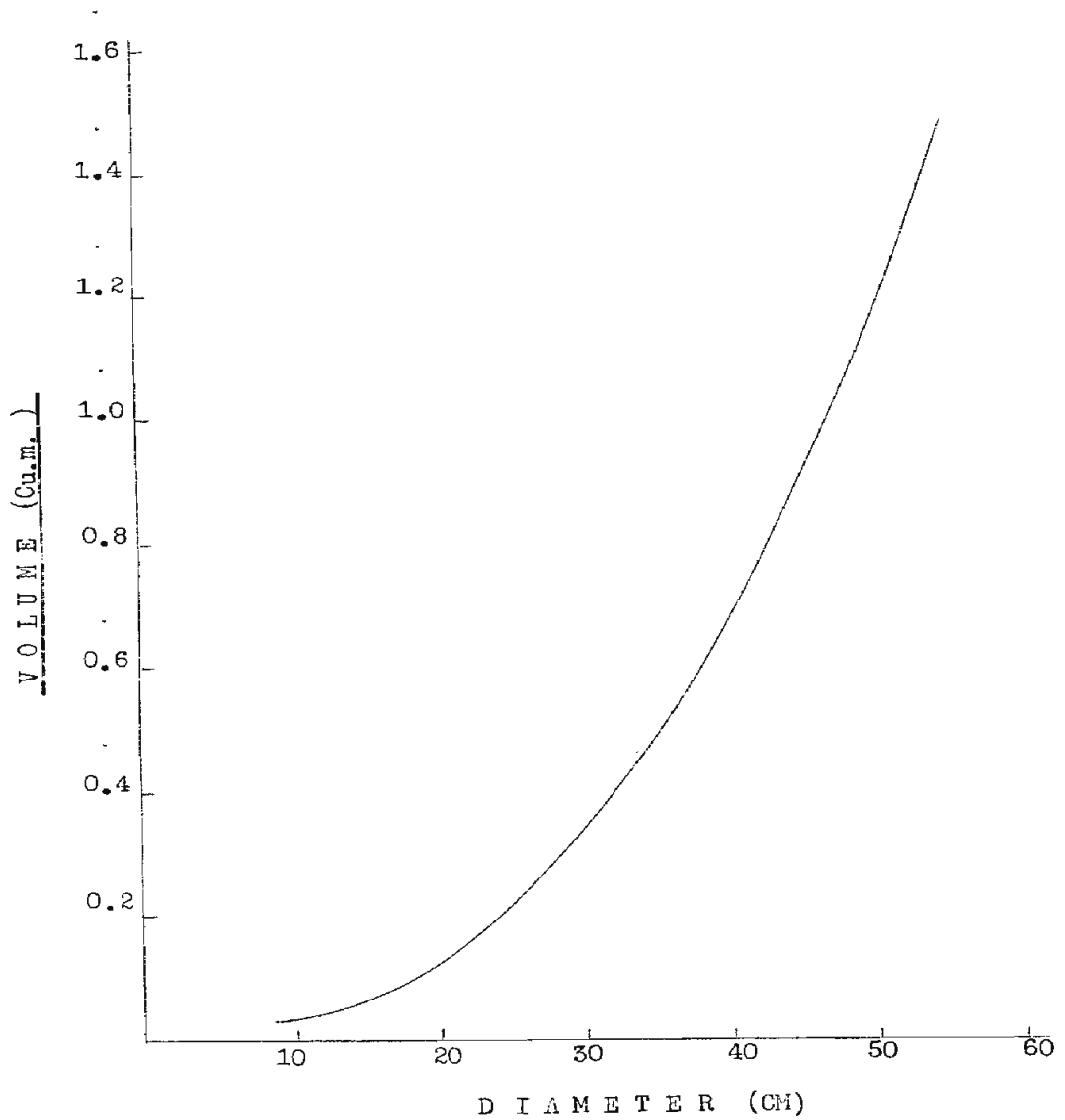


RAJASTHAN SURVEY

Species - REST

DIAMETER - VOLUME RELATION

DI. (CM)	VOL. (Cu.m.)
10.0	.012
12.5	.032
15.0	.062
17.5	.103
20.0	.152
22.5	.207
25.0	.271
27.5	.346
30.0	.436
32.5	.533
35.0	.628
37.5	.734
40.0	.861
45.0	.996
47.5	1.130
50.0	1.278
52.5	1.442
55.0	1.604



— 77 —
Table No. 1

Area (In Sq. Km.) under different forest types.								
S. No.	Name of Range.	Teak Type	Dhok Type	Salar & Godal type	Mixed with teak	Misc. without teak	Misc Others	Total
1.	Udaipur	-	11.259 (2.90)	247.585 (63.77)	-	84.366 (21.73)	45.037 (11.60)	388.247 (100.00)
2.	Parsad	5.995 (1.56)	-	276.218 (71.87)	42.046 (10.94)	36.012 (9.37)	24.059 (6.26)	384.330 (100.00)
3.	Salumber	69.021 (29.50)	-	128.449 (54.90)	22.929 (9.80)	-	13.571 (5.80)	233.97 (100.00)
4.	Kurabar	-	6.550 (3.33)	124.593 (63.34)	-	65.563 (33.33)	-	196.706 (100.00)
5.	Kherwara	51.128 (12.77)	-	110.745 (27.66)	110.745 (27.66)	127.762 (31.91)	-	400.380 (100.00)
6.	Gogunda	-	-	66.841 (41.18)	-	76.368 (47.05)	19.104 (11.77)	162.313 (100.00)
7.	Bansi	96.170 (38.06)	-	71.407 (28.26)	60.390 (23.90)	2.729 (1.08)	21.984 (8.70)	252.680 (100.00)
8.	Panarwa	9.061 (2.13)	-	85.164 (20.02)	9.061 (2.13)	316.790 (74.47)	5.317 (1.25)	425.393 (100.00)
9.	Jhadol	11.927 (2.50)	-	143.124 (30.00)	59.635 (12.50)	262.393 (55.00)	-	477.079 (100.00)
10.	Kotra	18.642 (2.50)	-	391.472 (52.50)	-	298.265 (40.00)	37.283 (5.00)	745.662 (100.00)
11.	Dhariawad	89.029 (19.51)	-	144.701 (31.71)	200.327 (43.90)	22.269 (4.88)	-	456.326 (100.00)
12.	Kumbalgarh	4.849 (1.14)	-	270.699 (63.64)	-	144.963 (34.09)	4.849 (1.14)	425.36 (100.00)
13.	Total	355.822 (7.82)	17.809 (0.39)	2060.998 (45.31)	505.133 (11.10)	1437.480 (31.61)	171.204 (3.77)	4548.446 (100.00)

(Figures in brackets give percentage area)

Table No. 2

Area (in Sq. Kms) under different Biotic interferences

S. No.	Names of Ranges	Biotic Interferences				Total
		Very Heavy	Heavy	Modarate	Absent	
1	2	3	4	5	6	7
1.	Udaipur	107.273 (27.63)	132.819 (34.21)	132.819 (34.21)	15.336 (3.95)	388.247 (100.00)
2.	Parasid	108.266 (28.17)	173.217 (45.07)	92.009 (23.94)	10.838 (2.82)	384.330 (100.00)
3.	Salumber	82.100 (35.09)	94.407 (40.35)	57.463 (24.56)	-	233.970 (100.00)
4.	Kurabar	44.891 (23.33)	98.353 (50.00)	45.891 (23.33)	6.571 (3.34)	196.706 (100.00)
5.	Kherwara	16.696 (4.17)	125.119 (31.25)	208.518 (52.08)	50.047 (12.50)	400.380 (100.00)
6.	Gogunda	23.876 (14.71)	33.420 (20.59)	57.280 (35.29)	47.737 (29.41)	162.313 (100.00)
7.	Bansi	27.466 (10.87)	27.466 (10.87)	159.289 (63.04)	38.459 (15.22)	252.680 (100.00)
8.	Panarwa	18.079 (4.25)	126.725 (29.79)	171.386 (40.43)	108.603 (25.53)	425.393 (100.00)
9.	Jhadol	147.656 (30.95)	102.238 (21.43)	193.122 (40.48)	34.063 (7.14)	477.079 (100.00)
10.	Kotra	18.642 (2.50)	74.566 (10.00)	540.605 (72.50)	111.849 (15.00)	745.662 (100.00)
11.	Dhariwad	44.537 (9.76)	122.433 (26.83)	233.730 (51.22)	55.626 (12.19)	456.326 (100.00)
12.	Kumbalgarh	31.689 (7.45)	81.456 (19.15)	248.878 (58.51)	63.337 (14.89)	425.360 (100.00)
TOTAL		672.171 (14.78)	1192.219 (26.21)	2141.590 (47.08)	542.466 (11.93)	4548.446 (100.00)

(Figures in bracket give percentage area)

Table No. 3

Area (in Sq. Kms.) under different Categories of Regeneration.

S.No.	Names of Ranges	Categories of Regeneration.				Total
		Profuse	Adequate	Scanty	Nil	
1	2	3	4	5	6	7
1.	Udaipur	-	22.518 (5.80)	163.141 (42.02)	202.588 (52.18)	388.247 (100.00)
2.	Parsad	-	18.025 (4.69)	126.099 (32.81)	240.206 (62.50)	334.330 (100.00)
3.	Salumber	-	-	100.935 (43.14)	133.035 (56.86)	233.970 (100.00)
6.	Kurabar	-	-	65.562 (33.33)	131.144 (66.67)	196.706 (100.00)
5.	Khorwara	17.056 (4.26)	42.600 (10.64)	221.490 (55.32)	119.234 (29.78)	400.380 (100.00)
6.	Gogunda	-	-	38.192 (23.53)	124.121 (76.47)	162.313 (100.00)
7.	Bansi	-	-	60.416 (23.91)	192.264 (76.09)	252.680 (100.00)
8.	Panarwa	18.122 (4.26)	54.323 (12.77)	253.407 (59.57)	99.541 (23.40)	425.393 (100.00)
9.	Jhadol	-	47.708 (10.00)	262.393 (55.00)	166.978 (35.00)	477.079 (100.00)
10.	Kotra	19.163 (2.57)	95.594 (12.82)	305.871 (41.02)	325.034 (43.59)	745.662 (100.00)
11.	Dhariawad	-	33.403 (7.32)	178.058 (39.02)	244.865 (53.66)	456.326 (100.00)
12.	Kumbalgarh	-	4.934 (1.16)	93.962 (22.09)	326.464 (76.75)	425.360 (100.00)
13.	TOTAL	54.341 (1.19)	319.105 (7.01)	1869.526 (41.11)	2305.474 (50.69)	4548.446 (100.00)

(Figures in brackets give percentage area)

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Table No. 4
Area (In Sq. Kms.) under different potential classes

S.No.	Name of Range	Potential Classes			
		Potential	Not Potential	Not applicable	Total
1.	Udaipur	216.176 (55.68)	4.426 (1.14)	167.645 (43.18)	388.247 (100.00)
2.	Parsad	223.027 (58.03)	4.727 (1.23)	156.576 (40.74)	384.330 (100.00)
3.	Salumber	95.179 (40.22)	7.932 (3.39)	130.859 (55.93)	233.970 (100.00)
4.	Kurabar	92.885 (47.22)	21.854 (11.11)	81.967 (41.67)	196.706 (100.00)
5.	Kherwara	92.408 (23.08)	38.516 (9.62)	269.456 (67.30)	400.380 (100.00)
6.	Gogunda	85.425 (52.63)	17.091 (10.53)	59.797 (36.84)	162.313 (100.00)
7.	Bansi	48.590 (19.23)	9.728 (3.85)	194.362 (76.92)	252.680 (100.00)
8.	Panorwa	130.893 (30.77)	16.378 (3.85)	278.122 (65.38)	425.393 (100.00)
9.	Jhadol	144.221 (30.23)	-	332.858 (69.77)	477.079 (100.00)
10.	Kotra	130.491 (17.50)	18.641 (2.50)	596.530 (80.00)	745.662 (100.00)
11.	Dhariawad	62.243 (13.64)	10.359 (2.27)	383.724 (84.09)	456.326 (100.00)
12.	Kambalgarh	159.510 (37.50)	36.794 (8.65)	229.056 (53.85)	425.360 (100.00)
13.	Total	1481.048 (32.56)	186.446 (4.10)	2880.952 (63.34)	4548.446 (100.00)

(Figures in brackets give percentage area)

Table No. 5
Distribution of Stems per Hectare by Species and Diameter class (RANGE - UDALPUR)
Diameter Classes in Cm. (BHCB)

Species	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	Total	%
<i>Terminalia glauca</i>	-	0.070	-	0.070	-	-	-	0.070	0.210	.1
<i>Anogeissus latifolia</i>	18.182	6.321	1.491	0.355	0.070	-	0.070	-	26.489	15.2
<i>Anogeissus pendula</i>	0.572	1.066	1.491	0.850	0.495	-	-	-	4.474	2.6
<i>Lannea coromandelica</i>	6.182	7.171	4.335	2.063	1.708	0.641	0.355	0.216	22.671	13.0
<i>Adina cordifolia</i>	-	-	-	-	-	-	-	-	-	-
<i>Acacia catechu</i>	5.116	1.136	0.355	0.070	-	-	-	-	6.677	3.8
<i>Wrightia tinctoria</i>	12.147	3.694	2.488	0.425	0.070	-	-	-	18.824	10.8
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-	-	-
<i>Tectona grandis</i>	-	-	-	-	-	-	-	-	-	-
<i>Boswellia serrata</i>	9.304	6.815	4.474	3.694	3.408	2.133	0.850	1.708	32.386	18.6
<i>Diospyros melanoxylon</i>	0.572	0.495	0.070	0.139	0.355	0.070	-	-	1.701	1.0
<i>Milusa tomentosa</i>	0.850	0.139	0.139	-	-	-	-	-	1.128	.6
Rest of species	33.327	14.990	6.044	3.330	1.119	0.695	0.209	0.0	59.714	34.3
Total	86.252	41.897	20.887	10.996	7.225	3.539	1.484	1.994	174.274	
Percentage	49.5	24.1	12.0	6.3	4.1	2.0	0.9	1.1		

Table No. 6
Distribution of Stems per Hectare by species and Diameter class (RANGE - PARSAD)

Species	Diameter Classes in Cm. (BHC)						Total	%
	5-10	10-15	15-20	20-25	25-30	30-35		
<i>Terminalia belerica</i>	-	-	-	0.078	-	-	0.078	.1
<i>Anogeissus latifolia</i>	16.979	5.942	3.166	0.614	0.156	0.078	26.935	17.6
<i>Anogeissus pendula</i>	0.078	-	-	-	-	-	0.078	.1
<i>Lannea coromandelica</i>	5.328	6.479	4.472	4.324	1.929	1.159	23.847	15.6
<i>Mimosa cordifolia</i>	0.233	-	0.078	-	0.078	-	0.467	0.3
<i>Acacia catechu</i>	0.848	0.311	0.156	-	-	-	1.315	0.8
<i>Wrightia tinctoria</i>	9.411	2.932	1.392	0.233	0.078	-	14.046	9.2
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-
<i>Tectona grandis</i>	6.712	0.926	0.311	-	0.078	-	8.027	5.3
<i>Boswellia serrata</i>	4.394	5.017	7.179	6.868	4.550	2.543	32.713	21.5
<i>Diospyros melanoxylon</i>	2.318	0.467	0.156	-	-	-	2.941	1.9
<i>Millettia tomentosa</i>	0.078	-	-	-	-	-	0.078	.1
Rest of species	22.011	9.193	5.327	2.560	1.469	0.389	42.030	27.5
Total	68.390	31.267	22.237	14.677	8.338	4.169	152.555	
Percentage	44.9	20.5	14.6	9.6	5.5	2.6		

Table No. 7

Distribution of Stems per Hectare by Species And Diameter Class (RANGE - SALUMBER)

Species	Diameter Classes In Cm. (BHCB)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belorica</i>	-	-	-	0.109	-	0.109	0.109	0.211	0.538	.3
<i>Anogeissus latifolia</i>	2.861	3.181	3.072	1.380	0.211	0.211	0.109	-	11.025	5.7
<i>Anogeissus pendula</i>	-	-	-	-	-	-	-	-	-	-
<i>Lannea coromandelica</i>	2.222	2.361	2.012	2.121	2.222	2.331	1.060	0.530	15.359	8.0
<i>Adina cordifolia</i>	-	-	0.211	-	-	-	-	-	0.211	.1
<i>Acacia catechu</i>	0.109	-	0.211	-	-	-	-	-	0.320	.2
<i>Wrightia tinctoria</i>	5.083	3.392	1.060	0.211	-	0.109	-	-	9.855	5.1
<i>Terminalia tomentosa</i>	-	-	-	-	-	0.109	-	-	0.109	.1
<i>Tectona grandis</i>	65.148	14.778	4.023	1.910	0.109	-	0.109	0.109	86.136	44.8
<i>Boswellia serrata</i>	1.271	1.271	2.752	2.861	2.222	1.330	1.481	1.380	14.618	7.6
<i>Diospyros mesoxylon</i>	11.126	3.181	1.481	1.060	0.530	-	-	-	17.378	9.0
<i>Millettia tomentosa</i>	1.271	0.211	0.211	0.211	0.109	-	-	-	2.013	1.1
Rest of species	20.350	7.421	3.094	1.824	0.639	0.320	0.329	0.538	34.515	18.0
Total	109.441	36.246	18.127	11.687	6.042	4.569	3.197	2.768	192.077	
Percentage	57.0	18.9	9.4	6.1	3.1	2.4	1.7	1.4		

Table No. 8
Distribution of Stems per Hectare By Species And Diameter Class (RANGE - KURABAR)

Species	Diameter Classes In Cm. (BHOB)									Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+			
<i>Terminalia belerica</i>	-	-	-	-	-	-	-	-	-	-	-
<i>Anogeissus latifolia</i>	5.212	1.216	0.524	0.177	0.177	0.177	-	-	7.483	7.0	
<i>Anogeissus pendula</i>	1.039	0.346	-	0.177	-	-	-	-	1.562	1.4	
<i>Lannea coromandelica</i>	0.346	1.563	1.909	1.909	1.039	1.740	0.346	0.346	9.198	8.6	
<i>Adina cordifolia</i>	-	-	-	-	-	-	-	-	-	-	
<i>Acacia catechu</i>	3.472	1.216	0.524	0.346	0.346	-	-	-	5.904	5.5	
<i>Wrightia tinctoria</i>	4.342	1.039	0.346	0.524	-	0.177	0.177	-	6.605	6.1	
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-	-	-	
<i>Tectona grandis</i>	-	-	-	-	-	-	-	-	-	-	
<i>Boswellia serrata</i>	0.693	1.563	2.948	4.857	4.342	2.948	0.693	1.386	19.430	18.1	
<i>Diospyros melanoxylon</i>	1.386	-	0.346	-	0.177	-	-	-	1.909	1.8	
<i>Mil-usa tomentosa</i>	-	-	-	-	-	-	-	-	-	-	
Rest of species	28.677	15.774	5.567	3.489	1.048	0.694	0	0	55.249	51.5	
Total	45.167	22.717	12.164	11.479	7.129	5.736	1.216	1.732	107.340		
Percentage	42.1	21.2	11.3	10.7	6.7	5.3	1.1	1.6			

Table No. 9
Distribution of Stems per Hectare by Species and Diameter Class (RANGE - KHERWARA)

Species.	Diameter Classes In Cm. (BHCB)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	0.479	0.244	0.362	0.117	-	-	0.362	0.117	1.681	.5
<i>Anogeissus latifolia</i>	48.555	17.788	5.052	1.446	0.841	0.362	-	-	74.044	21.5
<i>Anogeissus pendula</i>	0.117	-	-	-	-	-	-	-	0.117	.1
<i>Lannea coromandelica</i>	10.036	10.575	5.170	3.362	1.446	0.958	0.244	0.117	31.968	9.3
<i>Adina cordifolia</i>	0.117	-	0.479	-	-	-	0.117	0.117	0.830	0.2
<i>Acacia catechu</i>	11.542	2.648	-	-	-	-	-	-	14.190	4.1
<i>Wrightia tinctoria</i>	4.447	2.648	1.202	0.597	0.244	0.117	-	-	9.255	2.7
<i>Terminalia tomentosa</i>	3.245	3.245	1.681	0.362	0.479	-	-	0.117	9.129	2.7
<i>Toctona grandis</i>	21.873	6.490	3.001	0.479	0.244	-	-	-	32.087	9.3
<i>Boswellia serrata</i>	4.808	12.139	10.819	5.052	3.245	1.320	1.446	0.362	39.191	11.4
<i>Diospyros melanoxylon</i>	28.799	5.532	2.043	0.479	0.244	0.117	-	-	35.214	10.2
<i>Milusa tomentosa</i>	6.011	4.447	0.958	0.244	-	-	-	-	11.660	3.4
Rest of species	47.706	17.181	8.153	5.406	2.630	1.781	0.714	1.177	84.648	24.6
Total	185.796	82.937	38.920	17.544	9.373	4.655	2.883	1.907	344.014	
Percentage	54.0	24.1	11.3	5.1	2.7	1.4	.8	.6		

Table No. 10
Distribution of Stems per Hectare by Species and Diameter Class (RANGE - COGUNDA)

Species	Diameter Classes In Cm. (BHCB)									Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+			
<i>Terminalia belerica</i>	-	0.331	0.161	0.161	-	0.161	-	0.161	0.975	0.975	3
<i>Anogeissus latifolia</i>	82.405	25.661	6.254	1.977	1.807	0.161	0.161	0.161	118.587	118.587	32.9
<i>Anogeissus pendula</i>	-	-	-	-	-	-	-	-	-	-	-
<i>Lannea coromandelica</i>	10.853	8.554	6.415	4.608	2.801	0.662	0.161	-	34.054	34.054	9.5
<i>Adina cordifolia</i>	1.315	0.492	0.161	0.331	-	-	0.161	-	2.460	2.460	0.7
<i>Acacia catechu</i>	2.631	0.331	-	-	-	-	-	-	2.962	2.962	0.8
<i>Wrightia tinctoria</i>	50.329	6.733	3.615	1.646	-	-	-	-	63.983	63.983	17.8
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-	-	-	-
<i>Tectona grandis</i>	-	-	-	-	-	-	-	-	-	-	-
<i>Boswellia serrata</i>	5.261	7.569	5.923	4.438	3.785	2.631	0.984	0.492	31.083	31.083	8.6
<i>Diospyros melanoxylon</i>	-	-	-	-	-	-	-	-	-	-	-
<i>Millettia tomentosa</i>	2.962	0.823	0.662	0.161	-	-	-	-	4.608	4.608	1.3
Rest of species	55.438	22.369	13.645	4.439	2.469	1.789	0.322	0.814	101.285	101.285	26.1
Total	211.194	74.523	36.836	17.761	10.862	5.404	1.789	1.628	359.997	359.997	
Percentage	58.7	20.7	10.2	4.9	3.0	1.5	0.5	0.5			

Table No. 11
Distribution of Stems per Hectare by species and Diameter class (RANGE - BANSI)

Species	Diameter Classes In Cm. (BHOB)							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40		
<i>Terminalia belerica</i>	-	-	-	-	-	-	-	-	-
<i>Anogeissus latifolia</i>	21.638	6.369	3.123	1.566	1.203	-	-	33,899	8.8
<i>Anogeissus pendula</i>	0.239	-	-	-	-	-	-	0.239	0.1
<i>Lannea cormandela</i>	15.661	10.453	8.174	4.565	2.521	1.566	0.840	44,708	11.6
<i>Adina cordifolia</i>	0.478	-	-	0.124	-	-	0.124	0.726	0.2
<i>Acacia catechu</i>	7.572	1.631	0.239	0.363	0.124	-	-	9,979	2.6
<i>Wrightia tinctoria</i>	5.051	1.203	1.566	1.079	0.124	0.124	0.124	9,271	2.4
<i>Terminalia tomentosa</i>	0.239	0.478	0.478	-	0.124	-	0.124	1,443	0.4
<i>Tectona grandis</i>	97.113	31.855	8.413	3,246	1.079	0.363	0.363	142,556	37.0
<i>Boswellia serrata</i>	0.363	0.602	0.363	0.840	1.566	1.805	1.442	9,024	2.3
<i>Diospyros melanoxylon</i>	23.681	7.811	2.884	2.282	0.239	0.239	-	37,136	9.6
<i>Milusa tomentosa</i>	0.363	0.363	0.239	0.124	-	-	-	1,089	0.3
Rest of species	59.640	17.674	7.818	4.096	2,538	1.688	0.725	95,029	24.7
Total	232,238	78,492	33,297	18,285	9,518	5,785	3,618	385,099	
Percentage	60.3	20.4	8.6	4.7	2.5	1.5	1.0		

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Table No. 12
Distribution of Stems per Hectare by Species and Diameter Class (RANGE - PANARWA)

Species	Diameter Classes In Cm. (BHCB)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	1.085	0.958	0.479	0.117	0.596	-	-	-	3.235	0.6
<i>Anogeissus latifolia</i>	68.267	12.862	2.648	1.085	0.361	-	-	0.117	85.340	16.2
<i>Anogeissus pendula</i>	0.117	0.117	0.117	-	-	-	-	-	0.351	0.1
<i>Lannea coromandelica</i>	15.627	14.064	7.330	6.011	3.606	1.799	1.085	0.723	50.245	9.5
<i>Adina cordifolia</i>	1.781	1.564	0.244	0.479	-	0.479	0.117	0.958	5.522	1.0
<i>Acacia catechu</i>	3.362	0.841	-	-	-	-	-	-	4.203	0.8
<i>Wrightia tinctoria</i>	38.224	8.415	0.723	0.244	0.117	-	-	-	47.723	9.1
<i>Terminalia tomentosa</i>	9.011	4.691	1.446	1.085	0.244	0.244	-	0.117	16.838	3.2
<i>Tectona grandis</i>	3.606	2.043	0.723	0.479	0.117	0.244	-	-	7.212	1.4
<i>Boswellia serrata</i>	2.833	2.043	2.648	2.404	2.766	0.841	0.596	0.479	14.660	2.8
<i>Diospyros melanoxylon</i>	48.193	18.149	5.531	1.564	0.361	0.244	-	-	74.042	14.1
<i>Milusa tomentosa</i>	15.266	4.447	0.596	0.723	-	-	0.117	-	21.149	4.0
Rest of species	114.059	43.989	21.370	9.381	3.953	1.445	0.724	1.447	196.368	37.2
Total	521.381	114.183	43.855	23.572	12.121	5.296	2.639	3.841	526.888	-
Percentage	61.0	21.7	8.3	4.5	2.3	1.0	0.5	0.7	-	-

Table No. 13
Distribution of Stems per Hectare by Species and Diameter Class (Range - JHADOL)

Species	Diameter Classes in cm. (BHOB)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	0.585	0.585	0.585	0.293	0.146	-	-	0.146	2.340	0.7
<i>Anogeissus latifolia</i>	48.255	26.304	4.363	1.308	-	0.146	0.146	-	80.522	24.4
<i>Anogeissus pendula</i>	0.146	-	-	-	-	-	-	-	0.146	0.1
<i>Lantana coromandelica</i>	12.786	6.540	5.378	3.201	1.015	0.585	0.146	0.293	29.944	9.1
<i>Adina cordifolia</i>	0.585	0.585	0.585	0.439	0.293	0.293	0.293	0.146	3.219	1.0
<i>Acacia catechu</i>	0.439	-	-	-	-	-	-	-	0.439	0.1
<i>Wrightia tinctoria</i>	23.835	8.140	2.031	1.893	0.293	-	0.146	-	36.338	11.0
<i>Terminalia tomentosa</i>	0.146	0.293	0.146	0.146	0.146	0.146	-	0.146	1.169	.4
<i>Tectona grandis</i>	8.453	4.070	0.293	0.293	-	0.146	-	-	13.235	4.0
<i>Boswellia serrata</i>	2.031	4.216	1.893	1.747	2.523	1.015	0.869	1.162	15.256	4.6
<i>Diospyros melanoxylon</i>	8.140	2.177	0.723	-	-	-	-	-	11.040	3.3
<i>Milusa tomentosa</i>	4.070	1.162	-	0.146	0.146	-	-	-	5.524	1.7
Rest of species	77.494	32.852	9.765	5.240	2.186	0.586	0.732	1.600	130.455	39.6
Total	186.945	86.924	25.762	14.706	6.548	2.917	2.332	3.493	329.627	
Percentage	56.7	26.4	7.8	4.4	2.0	0.9	0.7	1.1		

Table No. 14.
Distribution of Stems per Hectare by Species and Diameter Class (RANGE - KOTRA)

Species	Diameter Classes In Cm. (BHC)							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	
<i>Terminalia belerica</i>	0.320	0.430	0.480	-	-	0.160	-	0.160	1.600 0.4
<i>Anogeissus latifolia</i>	86.220	15.220	4.650	2.720	0.960	0.160	-	-	109.930 28.8
<i>Anogeissus pendula</i>	-	-	-	-	0.160	-	-	-	0.160 0.1
<i>Lannea coromandelica</i>	7.370	9.150	6.410	5.930	3.850	2.560	1.600	0.960	37.810 9.9
<i>Adina Cordifolia</i>	0.800	0.480	0.160	0.160	0.160	-	0.320	0.320	2.400 0.6
<i>Acacia catechu</i>	1.120	0.640	0.160	0.160	-	-	-	-	2.080 0.5
<i>Wrightia tinctoria</i>	27.720	10.100	2.720	1.440	0.320	-	-	-	42.300 11.1
<i>Terminalia tomentosa</i>	-	0.320	-	-	0.160	-	-	0.160	0.640 0.2
<i>Tectona grandis</i>	2.720	2.080	0.320	-	-	-	-	-	5.120 1.3
<i>Boswellia serrata</i>	1.760	1.920	2.720	6.090	6.570	3.530	2.400	3.850	28.840 7.5
<i>Diospyros melanoxylon</i>	19.550	8.970	3.850	1.220	0.640	0.320	0.160	-	34.770 9.1
<i>Milusa tomentosa</i>	4.970	1.440	0.640	0.160	-	0.320	-	0.160	7.690 2.0
Rest of species	49.510	26.580	15.380	8.480	4.640	1.920	0.640	1.600	108.750 28.5
Total	202.060	77.360	37.490	26.420	17.460	6.970	5.120	7.210	382.090
Percentage	52.9	20.3	9.8	6.9	4.6	2.3	1.3	1.9	

Table No. 11
Distribution of Stems per Hectare by species and Diameter class (RANGE - DHARIBAD)

Species	Diameter Classes in Cm. (BHOB)							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40		
<i>Terminalia belorica</i>	0.140	-	-	-	-	-	-	0.140	1.04
<i>Anogeissus latifolia</i>	33.378	12.496	4.827	2.274	1.705	0.140	0.140	55.240	14.1
<i>Anogeissus pendula</i>	-	-	-	-	-	-	-	-	-
<i>Lannea coromandelica</i>	8.097	6.252	6.961	7.240	4.547	2.274	0.997	36.797	9.4
<i>Adina cordifolia</i>	-	-	-	-	-	-	0.140	0.280	1.1
<i>Acacia catechu</i>	15.058	2.553	0.140	-	-	0.140	-	17.891	4.6
<i>Whightia tinctoria</i>	5.395	2.413	0.140	0.140	-	-	-	8.088	2.1
<i>Terminalia tormentosa</i>	0.700	0.703	0.568	0.289	-	-	-	2.273	0.6
<i>Tectona grandis</i>	100.851	36.782	17.332	4.827	2.274	0.848	0.140	165.194	42.3
<i>Boswellia serrata</i>	0.848	0.429	1.985	0.848	2.553	2.702	1.565	12.097	3.1
<i>Diospyros melanoxylon</i>	20.174	7.100	3.122	1.277	0.568	0.429	-	32.810	8.4
<i>Milusa tormentosa</i>	0.140	-	0.429	-	-	-	0.140	0.709	0.2
Rest of species	30.787	11.043	7.210	3.512	2.545	1.835	0.987	58.905	15.1
Total	215.576	81.776	42.714	20.407	14.192	8.368	4.109	325.2	390.394
Percentage	55.2	24.0	11.0	5.2	3.6	2.1	1.1	0.9	

Table No. 16
Distribution of Stems per Hectare by species and Diameter Class (RANGE - KUMBHALGARH)

Species	Diameter Classes In Cm. (BHOB)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belarica</i>	0.060	0.060	-	0.060	-	-	0.060	-	0.240	1
<i>Anogeissus latifolia</i>	35.149	9.468	3.653	1.797	1.175	0.375	0.123	0.307	52.052	18.0
<i>Anogeissus pendula</i>	9.054	2.597	0.681	0.128	0.128	0.060	-	-	12.628	4.4
<i>Lannea coromandlica</i>	5.449	5.194	3.593	3.159	3.278	1.856	1.175	0.494	24.198	8.4
<i>Adina cordifolia</i>	0.247	0.060	-	-	-	-	-	-	0.307	1
<i>Acacia catechu</i>	4.823	1.609	0.128	-	0.060	-	-	-	6.625	2.3
<i>Wrightia tinctoria</i>	18.196	9.903	4.700	1.984	0.681	0.060	-	-	35.524	12.3
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-	-	-
<i>Tectona grandis</i>	3.091	1.916	0.494	0.060	-	-	-	-	5.561	1.9
<i>Boswellia serrata</i>	9.775	3.232	5.569	6.190	5.569	4.828	3.031	0.240	47.403	16.4
<i>Diospyros melanoxylon</i>	3.159	1.175	0.741	0.187	0.128	-	-	-	5.390	1.9
<i>Milusa tomentosa</i>	3.338	0.300	0.741	0.187	0.187	0.060	-	0.128	5.441	1.9
Rast of species	50.604	21.491	9.851	5.023	2.528	1.744	0.749	1.225	93.215	32.3
Total	142.930	63.495	30.151	18.775	13.734	8.983	5.143	5.573	288.584	
Percentage	49.5	22.0	10.4	6.5	4.8	3.1	1.8	1.9		

Table No. 17
Distribution of Volume (m³) Per Hectare by Species and Diameter Class (Range - UDIPUR)

Species.	Diameter Classes in Cm. (BHC)							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	
<i>Acrocybus latifolia</i>	0.309	0.309	0.197	0.061	0.022	0	0.050	0	1.048 7.3
<i>Larrea promarginalia</i>	0.056	0.236	0.407	0.397	0.533	0.302	0.236	0.369	2.586 18.0
<i>Boswellia serrata</i>	0.121	0.195	0.426	0.727	1.177	1.074	0.611	1.033	6.269 43.7
Rost	0.603	1.027	0.932	0.770	0.548	0.306	0.119	0.060	4.445 31.0
Total	1.169	1.897	1.962	1.975	2.280	1.682	1.016	2.367	14.348
Percentage	3.1	13.2	13.6	13.3	16.0	11.7	7.1	16.5	

Table No. 18

Distribution of Volume (M³) Per Hectare by Species and Diameter class (RANGE - PARSHAD)

Species	Diameter Class in Cm. (BHCB)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
Anogeissus latifolia	0.239	0.391	0.406	0.135	0.050	0.031	0	0	1.302	8.5
Lamaca coremandilica	0.043	0.265	0.415	0.833	0.611	0.574	0.047	0.064	2.855	18.5
Tectona grandis	0.087	0.035	0.033	0	0.027	0	0	0	0.182	1.2
Boswellia serrata	0.057	0.176	0.701	1.360	1.552	1.279	0.759	1.320	7.204	46.8
Rest	0.454	0.621	0.638	0.447	0.440	0.155	0.188	0.921	3.864	25.0
Total	0.935	1.486	2.193	2.775	2.680	2.039	0.994	2.305	15.407	
Percentage	6.1	9.6	14.2	18.0	17.4	13.2	6.5	16.0		

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Table No. 19
Distribution of Volume (M³) Per Hectare by Species and Diameter class (RANGER - SALUNGER)

Species	Diameter Classes In Cm. (BHCB)							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	
Anogeissus latifolia.	0.049	0.219	0.393	0.305	0.062	0.095	0.062	0	1.185 6.9
Lannea coromandelica	0.020	0.110	0.193	0.433	0.736	1.175	0.737	0.609	4.013 23.6
Tectona grandis	0.847	0.633	0.394	0.353	0.028	0	0.072	0.086	2.463 14.5
Boswellia serrata	0.016	0.045	0.307	0.598	0.789	0.715	1.071	1.751	5.292 31.1
Rest	0.493	0.665	0.576	0.546	0.358	0.241	0.251	0.950	4.080 23.9
Total	1.425	1.722	1.863	2.235	1.973	2.226	2.195	3.596	17.033
Percentage	3.4	10.1	10.9	13.1	11.6	13.1	12.9	19.9	

Table No. 20

Distribution of Volume (m^3) Per Hectare by Species and Diameter Class (RANGE - KRABAR)

Species	Diameter Classes In Cm. (BNCB)							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40		
Anogeissus latifolia	0.088	0.077	0.072	0.034	0.064	0.081	0	0.416	3.2
Lannea coromandilica	0.003	0.058	0.185	0.386	0.359	0.847	0.259	0.344	2.441
Boswellia serrata	0.009	0.053	0.294	1.032	1.478	1.403	0.478	1.777	6.524
Rest	0.506	0.877	0.573	0.712	0.392	0.350	0.090	0	3.500
Total	0.606	1.065	1.124	2.164	2.293	2.681	0.827	2.121	12.881
Percentage	4.7	8.3	8.7	16.8	17.8	20.8	6.4	16.5	

Table No. 21

Distribution of Volume (m^3) Per Hectare by Species and Diameter class (RANGE - KHERWARA)

Species	Diameter classes In Cm. (B.H.C.B.)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
Anoge-issus latifolia	0.825	1.087	0.633	0.284	0.275	0.150	0	0	3.254	13.7
Lannea coromandilica	0.091	0.397	0.530	0.640	0.466	0.469	0.169	0.109	2.871	12.1
Tectona grandis	0.284	0.304	0.238	0.085	0.069	0	0	0	1.030	4.3
Boswellia serrata	0.062	0.417	1.028	1.001	1.113	0.687	1.033	0.448	5.789	24.3
Rest	1.306	1.687	1.293	1.170	1.006	0.826	0.679	2.873	10.840	45.3
Total	2.568	3.392	3.772	3.180	2.929	2.132	1.881	3.430	23.784	
Percentage	10.8	16.4	15.8	13.4	12.3	9.0	7.9	14.4		

Table No. 22

Distribution of Volume (m^3) Per Hectare by Species and Diameter Classes (RANGE - GOGUNDA)

Species	Diameter Classes In Cm. (BHCB)							Total	%	
	5-10	10-15	15-20	20-25	25-30	30-35	35-40			
Anogeissus latifolia	1.401	1.527	0.787	0.435	0.607	0.071	0.111	0.126	5.065	21.9
Lantana coromandilica	0.096	0.341	0.630	0.922	0.917	0.311	0.106	0	3.325	14.4
Boswellia serrata	0.063	0.345	0.614	0.921	1.251	1.359	0.709	0.475	5.642	24.4
Rest	1.465	1.552	1.639	1.111	0.634	0.764	0.271	1.623	9.059	39.3
Total	3.032	3.665	3.670	3.389	3.409	2.505	1.197	2.224	23.091	
Percentage	13.1	15.9	15.9	14.7	14.8	10.8	5.2	9.6		

Table No. 23

Distribution of volum. (m³) Per Hectare by Species and Diameter classes (Range - BANSI)

Species	Diameter Classes In Cm. (BHC8)							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	
Anogeissus latifolia	0.368	0.398	0.390	0.526	0.403	0	0	0	1.885 7.3
Lannea coromandellica	0.143	0.389	0.770	0.890	0.804	0.800	0.505	0.776	5.157 20.1
Tectona grandis	1.262	1.454	0.774	0.578	0.311	0.158	0.225	0.038	4.840 18.9
Boswellia serrata	0.025	0.017	0.041	0.193	0.545	1.001	1.078	2.330	5.250 20.5
Rest	1.264	1.345	1.134	1.328	0.844	0.837	0.544	1.210	8.506 33.2
Total	3.042	3.533	3.109	3.305	2.907	2.796	2.432	4.464	25.638.
Percentage	11.9	14.0	12.1	12.9	11.3	10.9	9.5	17.4	

Table No. 24

Distribution of Volume (m³) per Hectare by Species and Diameter Classes (Range - PANARMA)

Species	Diameter Classes in Cm. (DHB)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
Anogeissus latifolia	1.150	0.747	0.337	0.224	0.100	0	0	0.101	2.673	8.6
Lannea coromandellica	0.177	0.525	0.713	1.110	1.133	0.630	0.750	0.771	6.059	19.4
Tectona grandis	0.047	0.069	0.082	0.101	0.034	0.109	0	0	0.462	1.5
Boswellia serrata	0.037	0.062	0.278	0.502	0.961	0.450	0.442	0.704	3.516	11.3
Rest	3.005	3.873	2.641	2.151	1.304	0.981	0.537	3.065	18.442	59.2
Total	4.334	5.301	4.056	4.118	3.623	2.420	1.729	5.521	31.152	
Percentage	12.1	17.0	15.0	15.2	11.6	7.8	5.6	17.7		

Table No. 25

Distribution of Volume (m³) per Hectare by Species and Diameter Classes (RANGE - JHADCL)

Species	Diameter Classes in Cm. (BHOB)							
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+ Total %
Anogeissus latifolia	0.820	1.574	0.558	0.275	0	0.061	0.088	0 3,376 14.4
Lannea coromandelica	0.145	0.232	0.493	0.655	0.300	0.237	0.114	0.009 2,536 10.9
Tectona grandis	0.110	0.182	0.031	0.052	0	0.074	0	0 0.449 1.9
Boswellia serrata	0.026	0.160	0.184	0.355	0.761	0.536	0.623	1,553 4,198 18.0
Rest	1.500	2.174	1.222	1.274	0.871	0.429	0.677	4,666 12,813 34.8
Total	2.571	4.324	2.588	2.591	1.941	1.397	1.502	6,558 23,372
Percentage	11.0	18.5	10.6	11.1	8.3	5.0	6.4	23.1

Table No. 26

Distribution of Volume (m^3) per Hectare by Species and Diameter Classes (Range - KCT3A)

Species	Diameter Classes in Cm. (BHCB)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
Anogeissus latifolia	1.466	0.856	0.548	0.595	0.310	0.068	-	-	3.843	10.0
Lannea coromandelica	0.067	0.339	0.619	1.143	1.225	1.234	1.076	0.899	6.652	17.3
Tectona grandis	0.035	0.104	0.025	-	-	-	-	-	0.164	0.4
Boswellia serrata	0.023	0.070	0.276	1.210	2.261	1.830	1.747	6.201	15.618	35.5
Rest of species	1.350	2.326	2.057	1.856	1.635	1.113	0.610	3.175	14.122	36.8
Total	2.941	3.745	3.525	4.804	5.431	4.245	3.433	10.275	38.399	
Percentage	7.6	9.8	9.2	12.5	14.1	11.1	8.9	26.8		

Table No. 27

Distribution of Volum. (m³) per Hectare by Species and Diameter Classes (RANGE - DHARIBAD)

Species	Diameter Classes in Cm. (BHC)							Total Y	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40		
Anogcissus latifolia	0.567	0.773	0.612	0.474	0.536	0.064	0.101	2.093	11.3
Lanuca coromandilica	0.073	0.254	0.702	1.404	1.467	1.039	0.652	0.572	6.213
Tectona grandis	1.311	1.848	1.636	0.880	0.610	0.387	0.097	0.173	6.942
Bes wellia serrata	0.011	0.010	0.202	0.182	0.885	1.378	1.131	1.596	5.437
Rest	0.942	1.109	1.029	0.842	0.814	0.973	0.755	1.257	7.721
Total	2.904	3.934	4.181	3.782	4.312	3.891	2.796	5.818	29.663
Per centage	3.8	15.5	14.1	12.7	14.5	13.1	9.4	12.9	

Table No. 20

Distribution of Volume (m^3) per Hectare by Species and Diameter Classes (Range - EUMEHALGPH)

Species	Diameter Classes In Cm. (BHOB)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Anogeissus latifolia</i>	0.597	0.553	0.465	0.383	0.405	0.164	0.080	0.266	2.913	9.0
<i>Acacia coromandelica</i>	0.020	0.100	0.342	0.581	1.064	0.992	0.908	0.596	4.531	14.0
<i>Tectona grandis</i>	0.040	0.91	0.047	0.010	--	--	--	--	0.108	0.6
<i>Boswellia serrata</i>	0.127	0.291	0.533	1.267	1.394	2.527	2.156	3.376	12.671	39.1
Rest of species	1.193	1.772	1.431	1.223	0.945	0.791	0.467	4.214	12.066	37.3
Total	1.976	2.096	2.873	3.464	4.308	4.304	3.511	8.952	32.369	
Percentage	6.1	8.9	8.9	10.7	13.3	13.5	10.9	27.7		

Table No. 29
Bamboo Clumps/Hectare in Each Range by Quality and Size Class

Range	Quality - I				Quality - II			
	S ₁	S ₂	S ₃	Total	S ₁	S ₂	S ₃	Total
Udaipur	43.75	53.13	15.62	112.50	103.75	33.75	0	142.50
Parasid	62.50	31.25	0	143.75	27.00	8.33	0	35.41
Salumbur	56.25	12.50	0	60.75	78.13	19.38	.62	90.13
Kumbalgarh	-	-	-	-	-	-	-	-
Kharwara	17.045	17.045	5.63	39.77	35.16	29.63	13.23	76.12
Gogunda	65.23	30.55	10.75	114.50	15.00	10.00	1.25	26.25
Bansi	41.15	27.60	9.37	76.12	27.27	10.80	6.82	44.89
Panarwa	103.04	63.61	27.23	193.88	7.81	0	0	7.81
Jhodol	173.12	79.33	13.75	266.25	13.12	10.00	5.00	28.12
Kotra	43.49	23.33	10.67	82.55	11.61	4.46	4.46	20.53
Dhariawad	36.25	34.33	23.12	93.75	25.00	11.46	5.21	41.67
Kumbalgarh	47.16	25.00	2.27	74.43	14.17	7.92	0.83	22.92
Total								

Table No.30
Total No. of Clumps in different Ranges by Quality and size class.

Range Size Class	Quality - I			Quality - II			Total	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	Total
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃								
Udaipur	115812	140643	41343	223867	85481	0	314348							
Parsad	29655	38552	0	38547	11057	0	50404							
Salumber	22307	4357	0	309032	76855	2459	389144							
Kurabar	-	-	-	-	-	-	-							
Rhewara	144364	144364	48107	216575	182220	31901	481196							
Gogunda	250953	117442	72030	32036	21357	2870	56063							
Bansi	239949	160933	54637	145762	57728	36454	239944							
Panarwa	2474739	1457036	623724	51113	0	0	51113							
Jhadol	1920742	880710	152554	145565	110949	55474	311938							
Kotra	1995620	1302728	489613	155384	53691	53691	274766							
Dharwad	375951	556557	239779	155536	71341	32420	259297							
Kumbalgarh	218475	115316	10516	83515	50032	5243	144790							
Total	7780567	4719743	1732358	1568762	728079	276212	2573053							

Table No. 31
Distribution of Stems (In '000') by species and Diameter classes. (RANGE - UDALPUR)

Species	Diameter Classes in Cm. (B.H.C.)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	-	2,717	-	2,717	-	-	-	2,717	8,151	.1
<i>Anogeissus latifolia</i>	705,916	245,412	57,888	13,782	2,717	-	2,717	-	1,028,432	15.2
<i>Anogeissus pinnatifida</i>	22,707	41,537	57,863	53,001	19,213	-	-	-	1,028,432	2.0
<i>Lannea coromandelica</i>	240,016	273,414	168,306	80,095	66,313	24,886	13,782	8,396	880,198	13.0
<i>Adina cordifolia</i>	-	-	-	-	-	-	-	-	-	-
<i>Acacia catechu</i>	198,628	44,105	13,782	2,717	-	-	-	-	259,232	3.8
<i>Wrightia tinctoria</i>	471,607	143,419	96,596	16,500	2,717	-	-	-	730,839	10.8
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-	-	-
<i>Tectona grandis</i>	-	-	-	-	-	-	-	-	-	-
<i>Boswellia serrata</i>	361,227	264,592	173,703	143,419	132,315	82,813	33,001	66,313	1,257,383	18.6
<i>Diospyros melanoxylon</i>	22,207	19,218	2,717	5,396	13,782	2,717	-	-	66,037	1.0
<i>Milusa tomentosa</i>	53,001	5,396	5,396	-	-	-	-	-	43,793	0.6
Rest of species	1293,920	581,986	234,658	129,287	43,445	26,983	8,114	-	2,318,393	34.3
Total	3,348,729	1,626,646	810,934	426,914	280,507	137,399	57,614	77,416	6,766,159	
Percentages	49.5	24.1	12.0	6.3	4.1	2.0	0.9	1.1		

Table No. 32
Distribution of Stems (in No) by species and Diameter Classes (Range - PARSHAD.)

Species	Diameter Classes in Cm. (BHR)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	-	-	-	2,997	-	-	-	-	2,997	.1
<i>Anogeisus latifolia</i>	652,553	228,368	124,678	23,597	5,995	2,997	-	-	1,035,188	17.6
<i>Anogeisus pandula</i>	2,997	-	-	-	-	-	-	-	2,997	.1
<i>Larrea coromandelica</i>	204,775	249,007	171,872	166,184	74,137	44,543	2,997	2,997	946,512	15.6
<i>Adina cordifolia</i>	8,549	-	2,997	-	2,997	-	2,997	-	17,585	0.3
<i>Acacia catuachu</i>	32,951	11,952	5,995	-	-	-	-	-	50,538	0.8
<i>Wrightia tinctoria</i>	361,692	112,685	53,498	8,954	2,997	-	-	-	539,826	9.2
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-	-	-
<i>Tectona grandis</i>	257,962	35,588	11,952	-	2,997	-	-	-	308,499	5.3
<i>Boswellia serrata</i>	152,074	192,010	275,910	263,057	174,870	97,735	41,546	41,546	1,257,256	21.5
<i>Diospyros melanoxylon</i>	89,087	17,948	5,995	-	-	-	-	-	113,030	1.9
<i>Milusa tomentosa</i>	2,997	-	-	-	-	-	-	-	2,997	.1
Rest of species	845,948	353,314	204,732	98,338	56,458	14,950	8,954	32,591	1,615,355	27.5
Total	2628,070	1201,680	854,629	564,077	320,451	160,225	56,494	77,134	5862,760	
Percentage	44.9	20.5	14.6	9.6	5.4	2.7	1.0	1.3		

Table No. 35

Distribution of Stems (In '000') by Species and Diameter Classes (Range - SALUMBAR)

Species	Diameter Classes in CM. (BHOR)							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40		
<i>Terminalia belarica</i>	-	-	-	2,550	-	2,550	2,550	4,936	12,586 .3
<i>Anogeissus latifolia</i>	66,938	74,425	71,875	32,287	4,936	4,936	2,550	-	257,947 5.7
<i>Anogeissus pendula</i>	-	-	-	-	-	-	-	-	-
<i>Lannea coromandelica</i>	51,988	66,938	47,074	49,625	34,988	52,538	62,500	12,400	352,562 5.9
<i>Adina corodifolia</i>	-	-	4,936	-	-	-	-	-	4,936 .1
<i>Acacia catechu</i>	2,550	-	4,936	-	-	-	-	-	7,486 .2
<i>Wrightia tinctoria</i>	118,926	79,362	24,800	4,936	-	2,550	-	-	230,574 5.1
<i>Terminalia tomentosa</i>	-	-	-	-	-	2,550	-	-	2,550 .1
<i>Tectona grandis</i>	1524,267	344,591	94,126	44,688	2,550	-	2,550	2,550	2015,322 44.8
<i>Boswellia serrata</i>	29,737	29,737	64,388	36,933	51,988	52,237	32,350	32,350	322,012 7.1
<i>Diospyros melanoxylon</i>	260,315	74,425	34,650	24,800	12,400	-	-	-	406,590 9.0
<i>Milusa tomentosa</i>	29,737	4,936	4,936	4,936	2,550	-	-	-	47,095 1.1
Rest of species	476,120	173,629	72,390	42,676	14,950	7,487	7,697	12,587	807,544 18.0
Total	2560,536	348,043	424,111	273,436	141,362	106,898	74,797	64,760	4493,993
Percentage	57.0	18.9	9.4	6.1	3.1	2.4	1.7	1.4	-

Table No. 34

Distribution of Species (in '000') by species and diameter classes. (RANGE - KURABAR)

Species	Diameter classes in cm. (B.D.B.)								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	-	-	-	-	-	-	-	-	-	-
<i>Anogeissus latifolia</i>	102,525	23,919	10,307	3,481	3,481	3,481	-	-	147,194	7.0
<i>Anogeissus pendula</i>	20,438	6,806	-	3,481	-	-	-	-	30,725	1.4
<i>Lannea coromandelica</i>	6,806	50,115	5,654	3,481	20,432	34,807	3,481	-	193,957	8.6
<i>Adina cordifolia</i>	-	-	-	-	-	-	-	-	-	-
<i>Acacia catechu</i>	68,297	23,919	10,307	6,806	3,806	-	-	-	116,135	5.5
<i>Wrightia tinctoria</i>	85,411	20,438	6,806	10,307	-	3,481	3,481	-	129,924	6.1
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-	-	-
<i>Tectona grandis</i>	-	-	-	-	-	-	-	-	-	-
<i>Ecsewillia serrata</i>	13,632	30,745	57,990	95,542	85,411	57,990	13,632	27,264	382,208	18.1
<i>Diospyros melanoxylon</i>	27,264	-	6,806	-	3,481	-	-	-	37,551	1.8
<i>Milusa tomentosa</i>	-	-	-	-	-	-	-	-	-	-
Rest of species	564,105	310,290	109,508	63,632	20,615	13,651	-	-	1086,801	51.5
Total	888,478	446,864	259,275	225,800	140,232	112,830	27,919	34,070	2111,466	
Percentage	42.1	21.2	11.3	10.7	6.7	5.3	1.1	1.6		

Table No. 55

Distribution of stems (in '000') by species and diameter classes RANGE - Kharwara

Species	Diameter classes in Cm. BHOB								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	19.178	9.769	14.493	4.684	-	-	14.493	4.684	67.301	9.5
<i>Anogeissus latifolia</i>	1944.045	712.195	202.271	57.894	33.671	14.493	-	-	2964.569	21.5
<i>Anogeissus paniculata</i>	4.684	-	-	-	-	-	-	-	4.684	1.1
<i>Lamnia coramandelica</i>	404.223	425.401	206.996	134.607	57.894	38.356	9.769	4.684	1279.930	9.3
<i>Adina cordifolia</i>	4.684	-	19.178	-	-	-	-	-	568.138	4.1
<i>Acacia catechu</i>	432.118	106.020	-	-	-	-	4.684	4.684	33.230	0.2
<i>Wrightia tinctoria</i>	175.048	106.020	48.125	23.902	9.769	4.684	-	-	370.548	2.7
<i>Terminalia tomentosa</i>	129.923	129.923	67.303	14.493	19.178	-	-	4.684	365.504	2.7
<i>Tectona grandis</i>	875.751	259.346	120.104	19.178	9.769	-	-	-	1284.696	9.3
<i>Boswellia serrata</i>	192.502	486.021	433.171	202.271	129.923	52.850	57.894	14.493	1569.125	11.4
<i>Diospyros melanoxylon</i>	1072.978	221.490	81.797	19.178	9.769	4.684	-	-	1409.896	10.2
<i>Milusa tomentosa</i>	240.668	178.048	38.356	9.769	-	-	-	-	466.841	3.4
Rest of species	1910.052	687.892	326.429	216.445	105.299	71.507	28.587	43.120	3389.131	24.6
Total	7438.854	3320.625	1558.273	402.421	375.272	186.574	115.427	76.349	13773.595	
Percentage	54.0	24.1	11.3	5.1	2.7	1.4	0.8	0.6		

Table No. 36

DISTRIBUTION OF STEMS (in '000') SPECIES AND DIAMETER CLASSES RANGE - GCGUNDA

Species	DIAMETER CLASSES IN Cm.							40+	Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40			
<i>Terminalia belerica</i>	-	5,372	2,613	2,613	-	2,613	-	2,613	15,824	3.3
<i>Anogeissus latifolia</i>	1337.515	416,503	101,508	32,088	29,329	2,613	2,613	2,613	1924.732	32.9
<i>Anogeissus pendula</i>	-	-	-	-	-	-	-	-	-	-
<i>Lannea coromandelica</i>	176,155	138,839	104,121	74,792	45,463	10,744	2,613	-	552,727	9.5
<i>Adina cordifolia</i>	21,343	7,965	2,613	5,372	-	-	2,613	-	39,926	0.7
<i>Acacia catechu</i>	42,703	5,372	-	-	-	-	-	-	48,075	0.8
<i>Wrightia tinctoria</i>	816,809	136,226	58,675	26,716	-	-	-	-	1038,506	17.8
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-	-	-
<i>Tectaria grandis</i>	-	-	-	-	-	-	-	-	-	-
<i>Boswellia serrata</i>	85,391	122,852	96,136	72,033	61,434	42,703	15,971	7,985	504,505	8.6
<i>Diospyros melanoxylon</i>	-	-	-	-	-	-	-	-	-	-
<i>Milusa tomentosa</i>	48,076	13,358	10,744	2,613	-	-	-	-	74,791	1.3
Rest of species	899,814	363,071	221,471	72,049	40,074	29,037	5,226	13,212	1643,954	28.1
Total	3427,886	1209,579	597,881	238,276	176,300	87,710	29,036	26,423	5843,090	-
Percentage	58.7	20.7	10.2	4.9	3.0	1.5	0.5	0.5	-	-

Table No. 37

DISTRIBUTION OF STEMS (in 000) BY SPECIES AND DIAMETER CLASSES RANGE - BANSI

Species	DIAMETER CLASSES IN Cm. BHCB							RANGE			Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+				
<i>Terminalia bellerica</i>	-	-	-	-	-	-	-	-	-	-	-	-
<i>Anogeissus latifolia</i>	546.743	160.931	78.911	39.569	30.397	-	-	-	-	856.556	8.9	-
<i>Anogeissus pendula</i>	6.039	-	-	-	-	-	-	-	-	6.039	0.1	-
<i>Lankea coromandelica</i>	400.775	264.802	206.540	115.848	63.700	39.569	41.443	16.319	1129.676	11.6	-	-
<i>Adina cordifolia</i>	12.070	-	-	3.133	-	-	3.133	-	18.344	0.2	-	-
<i>Acacia catechu</i>	191.329	42.475	6.039	9.172	3.133	-	-	-	252.148	2.6	-	-
<i>Wrightia tinctoria</i>	127.620	30.397	39.569	27.264	3.133	3.133	3.133	-	234.257	2.4	-	-
<i>Terminalia tomentosa</i>	6.039	12.070	12.070	-	3.133	-	-	3.133	36.461	0.4	-	-
<i>Tectona grandis</i>	2453.851	804.912	212.579	82.019	27.264	9.172	9.172	3.133	3602.102	37.0	-	-
<i>Boswellia serrata</i>	9.172	15.211	9.172	21.225	39.569	45.608	36.436	51.622	230.115	2.3	-	-
<i>Diospyros melanoxylon</i>	593.371	197.369	72.072	57.661	6.039	6.039	-	-	930.350	9.6	-	-
<i>Nilusa tomentosa</i>	9.172	9.172	6.039	3.133	-	-	-	-	27.516	0.3	-	-
Rest of species	1506.983	446.586	197.545	103.497	64.130	42.652	18.319	21.477	2401.189	24.7	-	-
Total	5365.185	1983.332	841.344	462.021	240.493	146.173	91.413	97.684	9730.655	-	-	-
Percentage	60.3	20.4	8.6	4.7	2.5	1.5	1.0	1.0	-	-	-	-

Table No. 33

Distribution of stems (in '000') by species and diameter classes (RANGE - PANAMA)

Species	Diameter Classes in Cm. BHCB							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40		
<i>Terminalia belerica</i>	46-154	40,752	20,376	4,977	25,353	-	-	137,612	0.6
<i>Anogeissus latifolia</i>	2904,009	547,136	112,643	46,154	15,356	-	4,977	3630,275	16.2
<i>Anogeissus pendula</i>	4,977	4,977	4,977	-	-	-	-	14,931	0.1
<i>Lanea coromandelica</i>	664,756	598,263	311,310	255,701	153,395	76,527	46,154	2137,366	9.5
<i>Adina cordifolia</i>	71,503	66,530	10,379	20,376	-	20,376	4,977	234,890	1.0
<i>Acacia catechu</i>	143,016	35,775	-	-	-	-	-	178,791	0.8
<i>Wrightia tinctoria</i>	1626,010	357,965	30,755	10,379	4,977	-	-	2030,086	9.1
<i>Terminalia tomentosa</i>	383,313	199,550	61,511	46,154	10,379	10,379	-	716,260	3.2
<i>Tectona grandis</i>	155,595	33,907	30,755	20,376	4,977	10,379	-	305,709	1.4
<i>Boswellia serrata</i>	122,639	86,907	139,043	102,263	117,662	35,775	25,353	623,613	2.8
<i>Diospyros melanoxylon</i>	2050,032	772,040	235,203	66,530	15,356	10,379	-	3149,670	14.1
<i>Milusa tomentosa</i>	649,400	189,170	25,355	30,755	-	-	4,977	899,655	4.0
Rest of species	1951,855	197,249	309,039	300,059	107,177	61,467	30,493	8353,294	37.2
Total	15671,219	4857,225	1885,543	1002,723	515,611	225,203	112,259	163,390	22413,253
Percentage	61.0	21.7	8.3	4.5	2.3	1.0	0.5	0.7	

Table No. 39

Distribution of Stems (in '000') by Species and Diameter Class (Range - JHMDCL)

Species	Diameter Classes in Cm. BHCB								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	27,909	27,909	27,909	13,978	6,965	-	-	6,965	111,653	.7
<i>Anogeisus latifolia</i>	2502,149	1254,911	203,150	62,402	-	6,965	6,965	-	3041,542	24.4
<i>Anogeisus pendula</i>	6,965	-	-	-	-	-	-	-	6,965	.1
<i>Lannea coromandelica</i>	609,994	312,010	256,573	152,713	48,423	27,909	6,965	13,978	1428,565	9.1
<i>Adina cordifolia</i>	27,909	27,909	27,909	20,943	13,978	13,978	13,978	6,965	153,569	1.0
<i>Acacia catechu</i>	20,943	-	-	-	-	-	-	-	20,943	0.1
<i>Wrightia tinctoria</i>	1137,120	368,343	36,834	30,311	13,978	-	6,965	-	1733,611	11.0
<i>Terminalia tomentosa</i>	6,965	13,978	6,965	6,965	6,965	6,965	-	6,965	55,768	.4
<i>Tectona grandis</i>	402,321	194,171	13,978	13,978	-	6,965	-	-	631,413	4.0
<i>Boswellia serrata</i>	96,894	201,136	90,311	83,345	110,025	48,423	41,458	55,436	727,823	4.6
<i>Diospyros melanoxylon</i>	303,343	103,360	34,492	-	-	-	-	-	526,695	3.3
<i>Milusa tomentosa</i>	194,171	55,436	-	6,965	6,965	-	-	-	263,537	1.7
Rest of species	3697,083	1567,303	465,860	249,909	104,239	27,956	34,922	76,332	6223,742	39.6
Total	8918,766	4146,966	1229,049	701,589	312,388	139,161	111,253	166,641	15725,813	
Percentage	56.7	26.4	7.8	4.4	2.0	0.9	0.7	1.1		

Table No. 40

Distribution of Stems (in '000') by species and diameter classes (RANGE - EXTRA)

Species	Diameter Classes in Cm. BHOB								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	23,861	35,791	35,791	-	-	11,930	-	11,930	119,303	0.4
<i>Anogeissus latifolia</i>	6429,090	1134,894	346,751	202,819	71,583	11,930	-	-	8197,037	28.8
<i>Anogeissus pendula</i>	-	-	-	-	11,930	-	-	-	11,930	0.1
<i>Terminalia tomentosa</i>	542,551	602,757	477,365	442,176	237,079	190,883	119,305	71,535	2819,337	9.9
<i>Adina cordifolia</i>	59,652	35,791	11,930	11,930	11,930	-	23,861	23,861	178,955	0.6
<i>Acacia catechu</i>	83,513	47,722	11,930	11,930	-	-	-	-	155,095	0.5
<i>Wrightia tinctoria</i>	2066,969	753,116	202,819	107,375	23,861	-	-	-	3154,140	11.1
<i>Terminalia tomentosa</i>	-	23,861	-	-	11,930	-	-	11,930	47,721	0.2
<i>Tectona grandis</i>	202,819	155,097	23,861	-	-	-	-	-	381,777	1.3
<i>Roswellia serrata</i>	131,236	143,166	292,319	454,103	439,893	263,217	173,359	237,779	2150,479	7.5
<i>Diospyros melanoxylon</i>	1457,765	668,857	237,079	95,444	47,722	23,861	11,930	-	2592,658	9.1
<i>Milusa tomentosa</i>	370,593	107,375	47,722	11,930	-	23,861	-	11,930	573,411	2.0
Rest of species	3691,762	1381,964	1146,325	632,319	345,986	143,166	47,722	119,305	8109,049	28.5
Total	15066,801	570,421	2795,475	1970,029	1301,919	668,853	381,776	537,618	29490,892	
Percentage	52.9	20.3	9.8	6.9	4.6	2.3	1.3	1.9		

Table No. 41.

Distribution of Storms (in 000.) by Species and diameter Classes RANGE - DHARWAD

Species	Diameter Classes in Cm. BHCB								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia balerica</i>	6.388	-	-	-	-	-	-	-	6.388	.04
<i>Anogeissus latifolia</i>	1523.138	570.229	220.270	103.769	77.804	6.388	6.388	12.777	2520.763	14.1
<i>Anogeissus pendula</i>	-	-	-	-	-	-	-	-	-	-
<i>Lannea coremandelica</i>	369.490	235.297	317.651	330.382	207.547	103.769	45.436	19,576	1679.208	9.4
<i>Adina cordifolia</i>	-	-	-	-	-	-	6.388	6.388	12.776	.1
<i>Acacia catechu</i>	687.141	116.501	6.388	-	-	6.388	-	-	816.418	4.6
<i>Wrightia tinctoria</i>	246.190	116.501	6.388	6.388	-	-	-	-	375.467	2.1
<i>Terminalia tomentosa</i>	32.303	32.303	25.919	13.107	-	-	-	-	103.722	.6
<i>Tectona grandis</i>	4602.133	1769.739	790.011	220.270	103.769	30.696	6.388	6.388	7538.294	42.3
<i>Boswellia serrata</i>	38.696	19.576	90.591	38.696	116.501	123.300	71.415	51.884	550.649	3.1
<i>Diospyros malenoxylon</i>	920.600	323.934	142.466	58.273	25.319	19.576	-	6.388	1497.216	8.4
<i>Milusa tomentosa</i>	6.388	-	19.576	-	-	-	6.388	-	32.352	.2
Rest of species	1404.903	503.925	323.013	160.263	116.135	83.736	45.039	44.994	2688.008	15.1
Total	9937.375	3733.070	1949.163	931.223	647.675	381.853	187.502	140,395	17921.261	
Percentage:	55.2	21.0	11.0	5.2	3.6	2.1	1.1	0.8		

Table No. 42

Distribution of stems (in 000) by species and diameter classes

RANGE - KUMBALGARH

Diameter Classes in Cm. BHOB

	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	Total	%
<i>Terminalia bellerica</i>	2,552	2,552	-	2,552	-	-	2,552	-	10,208	1
<i>Anogeissus latifolia</i>	1495,497	402,730	155,304	76,437	49,879	15,351	5,444	13,050	2214,080	10.0
<i>Anogeissus pendula</i>	304,270	110,465	23,987	5,444	5,444	2,552	-	-	537,142	4.4
<i>Adina cordifolia</i>	241,770	220,051	152,031	134,371	139,453	78,946	49,979	21,012	1029,231	8.4
<i>Adina cordifolia</i>	10,506	2,552	-	-	-	-	-	-	13,058	1
<i>Acacia catechu</i>	235,363	63,440	5,444	-	2,552	-	-	-	231,799	2.3
<i>Wrightia tinctoria</i>	773,935	421,234	193,919	94,391	23,367	552	-	-	1511,048	12.3
<i>Terminalia tomentosa</i>	-	-	-	-	-	-	-	-	-	-
<i>Tectona grandis</i>	131,478	81,493	21,012	2,552	-	-	-	-	236,540	1.9
<i>Boswellia serrata</i>	415,709	392,236	236,302	265,237	236,002	205,363	123,362	136,923	2016,328	16.4
<i>Diospyros melanoxylon</i>	134,371	49,979	31,519	7,954	5,444	-	-	-	229,267	1.9
<i>Milusa tomentosa</i>	141,935	54,023	31,519	7,954	7,954	2,552	-	5,444	231,436	1.9
Rest of species	2152,401	914,141	439,000	34,444	14,552	21,000	51,852	172,106	3964,990	32.3
Total	6079,665	2705,636	1233,499	739,610	584,136	592,093	219,760	229,543	12275,177	
Percentage	49.5	22.0	10.4	6.5	4.8	3.1	1.8	1.9		

Table No. 43

Table No. 3

DISTRIBUTION OF VOLUME (in '000' m³) BY SPECIES AND DIAMETER CLASSES (DIA. IN RANGE)

Species	Diameter classes (D.B.) in Cm. at B.H.						Total	
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+
1. Anogeissus latifolia	11.997	15.103	7.649	33.145	0.954		1.944	50.908
2. Lannea coromandelica	2.174	11.104	15.802	15.413	20.694	11.725	9.163	14.826
3. Boswellia serrata	4.696	7.571	16.539	28.226	45.697	41.693	23.722	75.242
4. Tectona grandis								243.393
5. Rest of species	28.517	39.873	36.135	29.895	21.276	11.830	4.626	2.829
Total	45.386	73.651	76.174	76.679	88.521	65.503	39.446	91.897
Percentage	8.1	13.2	13.6	13.8	16.0	11.7	7.1	16.8

Table No. 44

DISTRIBUTION OF VOLUME (in 1000 ft³) BY SPECIES AND DIAMETER CLASSES (PARSED RANGE)

2d. of 1000 ft

Species	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100
1. Anogeissus latifolia	11.107	15.027	15.601	15.188	1.922	1.922	1.922	1.922	1.922	1.922	1.922	1.922	1.922	1.922	1.922	1.922	1.922	1.922	1.922
2. Lannea coronadellia	1.845	10.100	15.950	32.015	23.483	22.061	1.806	2.460	1.09.728	18.5									
3. Tectona grandis	3.344	1.345	1.268		1.038														
4. Boswellia serrata	2.191	6.764	26.941	52.269	59.648	49.156	29.171	29.171	29.171	29.171	29.171	29.171	29.171	29.171	29.171	29.171	29.171	29.171	29.171
5. Rest of species	17.449	23.867	24.580	17.180	16.910	5.957	7.225	35.327	7.140	505	-25.0								
Total	35.966	57.114	84.283	106.652	103.001	103.001	103.001	103.001	103.001	103.001	103.001	103.001	103.001	103.001	103.001	103.001	103.001	103.001	103.001
Percentage	6.1	9.6	12.2	19.0	17.4	18.2	6.5	18.0	45.0	1.0	-2.5								

Table No. 45

DISTRIBUTION OF VOLUME (In '000 ft³) BY SPECIES AND DIAMETER CLASSES (SALUBER - RANGE)

	Diameter classes (D.B.) in Cms. at B.H.							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40		
1. Anogeissus latifolia	1,146	5,124	9,195	7,136	1,451	2,223	1,451	27,726	6.9
2. Euphorbia corollata	6,550	4,574	11,816	10,151	17,220	27,421	17,622	105,035	28.0
3. Tectonagrandis	19,817	15,980	9,218	8,259	0,655	-	1,685	57,626	14.5
4. Boswellia serrata	0,374	1,053	7,183	13,523	18,460	16,729	25,058	123,348	31.1
5. Rest of species	11,535	15,559	13,477	12,775	8,376	5,639	5,873	95,461	23.9
Total	33,340	40,290	43,589	51,824	46,162	52,082	51,311	79,456	398,054
Percentage	8.4	10.1	10.9	13.1	11.6	13.1	12.9	19.0	

Table No. 46

DISTRIBUTION OF VOLUME (in '000' m³) BY SPECIES AND DIAMETER CLASSES (RANGE - MURABAR)

Species	Diameter Classes (D.B.) in Cms. at B.H.							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	
Anogeissus latifolia	1.731	1.515	1.416	0.669	1.259	1.593	-	8.183	3.2
Lumnac coromandelica	0.059	1.141	3.639	7.593	7.062	16.661	5.095	6.767	48.017
Tectona grandis	-	-	-	-	-	-	-	-	-
Boswellia serrata	0.177	1.042	5.783	20.300	29.073	27.598	9.402	54.955	128.330
Rest of species	9.953	17.251	11.271	14.005	7.711	6.885	1.770	-	68.846
Total	11.920	20.949	22.109	42.567	45.105	52.737	16.237	41.722	253.376
Percentage	4.7	8.3	8.7	16.8	17.8	20.8	6.4	16.5	

Table No. 47

Distribution of volume (in '000' m³) by species and diameter classes (KIERWARA - RANGE)

	Diameter class (C.B.) in Cm. at B.H.							Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40		
a									
1. Anogeissus bifolia	33,031	43,521	25,344	11,371	11,010	6,006	-	130,283	13.7
2. Lamnea coromandlica	3,643	15,883	21,220	25,624	16,658	18,778	6,766	114,948	12.1
3. Tectona grandis			1,531	5,403	2,713	-	-	4,447	4.5
4. Boswellia serrata	2,482	16,636	41,159	40,078	44,562	27,506	41,359	231,779	24.3
5. Rest of species	52,290	67,544	51,769	46,844	40,278	33,071	27,186	434,011	45.6
Total	102,817	155,828	151,023	127,320	117,271	85,361	75,311	952,261	
Percentage	10.8	16.4	15.8	13.4	12.3	9.0	7.9	14.4	

Table No. 48

DISTRIBUTION OF VOLUME (IN '000' m³) BY SPECIES AND DIAMETER CLASSES (GGGUDA - RANGE)

Species	Diameter classes (C.B.) in Cms. at B.H.								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
1. <i>Anogeissus latifolia</i>	22,740	24,785	12,774	7,061	9,852	1,152	1,802	2,045	82,211	21.9
2. <i>Lannea coromandelica</i>	1,591	5,535	10,992	12,000	11,884	5,943	1,720		53,009	14.1
3. <i>Tectona grandis</i>	-	-	-	-	-	-	-	-	-	-
4. <i>Boswellia serrata</i>	1,104	3,977	9,966	14,949	20,305	22,058	11,503	7,710	91,577	24.4
5. Rest of species	23,779	25,191	26,603	18,033	10,291	12,401	4,399	23,343	147,040	39.3
Total	49,214	59,488	59,569	55,008	55,332	40,659	19,429	36,098	374,797	
Percentage	13.1	15.9	15.9	14.7	14.8	10.8	5.2	9.6		

Tabl. No. 49

Distribution of volume (in '000 m³) by species & diameter classes (DAISI - RANGE)

Species	Diameter classes (D.B.) in cm, at BH						
	5-10	10-15	15-20	20-25	25-30	30-35	35-40
							%
1. <i>Alnus incana</i>	9.297	10.057	9.554	6.257	10.165	-	47.523
2. <i>Larix sibirica</i>	3.515	9.329	19.456	22.400	20.315	20.214	14.702
3. <i>Taxus sibirica</i>	31.030	56.334	19.557	14.505	7.353	5.992	5.635
4. <i>Populus alba</i>	0.120	0.450	1.035	4.524	15.771	35.293	27.239
5. <i>Salix alba</i>	51.959	55.905	25.554	33.553	21.526	21.149	13.746
6. Total	76.063	90.535	73.557	63.510	73.453	70.643	51.452
7. <i>Salix alba</i>	11.9	14.0	12.1	12.9	11.3	10.9	9.5

Table No. 50.

DISTRIBUTION OF VOLUME (IN '000' m³) BY SPECIES & DIAMETER CLASSES (PANAMA - RANGE)

SPECIES	DIAMETER CLASSES (O.B.) IN CMS. AT B.H.								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
1. Anogeissus latifolia	49,260	31,777	14,336	9,529	4,509	-	-	4,296	113,707	8.6
2. Mannea coromandelica	5,828	22,333	30,543	48,495	48,410	37,435	31,904	32,798	257,746	19.4
3. Tectona grandis	1,999	3,786	3,488	4,296	1,446	4,637	-	-	19,652	1.5
4. Boswellia serrata	1,574	2,637	11,826	21,355	40,880	19,143	18,802	53,351	149,568	11.3
5. Rest of species	127,830	164,967	112,346	91,502	58,874	41,731	22,844	164,444	784,508	59.2
Total	186,491	225,500	172,539	175,177	154,119	102,946	73,550	234,859	1325,181	
Percentage	14.1	17.7	13.0	13.9	11.6	7.8	5.6	17.7		

Table No. 51.

DISTRIBUTION OF VOLUME (IN 1000 M³) BY SPECIES & DIAMETER CLASSES (JHADOL RANGE)

SPECIES	Diameter classes (C.B.) in Cms at B.H.								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
1. Anogeissus latifolia	59.120	75.092	26.621	13.120	-	2.910	4.198	-	161.061	14.4
2. Lannea coromandelica	5.486	11.164	23.520	30.294	14.742	14.169	5.439	16.173	120.987	10.9
3. Tectona grandis	5.248	8.603	1.479	2.481	-	3.530	-	-	21.421	1.9
4. Boswellia serrata	1.240	7.633	8.778	16.936	36.306	25.571	29.722	74.090	200.276	18.0
5. Rest of species	71.562	103.717	58.299	60.780	41.554	20.467	32.298	222.605	611.282	54.8
6. Total	122.656	206.280	118.697	123.611	92.602	66.647	71.657	312.068	1115.027	

Tabl. No. 52.

DISTRIBUTION OF VOLUME (IN '000 M³) BY SPECIES & DIAMETER CLASSES (MCTPA - RANGE)

SPECIES	Diameter classes (C.B.) in Gms. at B.H.								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
1. Anogeius us latifolia	109.314	63.929	40.862	44.367	23.115	5.070	--	--	236.557	10.0
2. Lannea coromandelica	4.996	29.006	46.156	85.229	91.344	92.015	20.233	67.035	436.014	17.3
3. Tectona grandis	2.610	7.755	1.864	--	--	--	--	--	12.229	0.4
4. Boswellia serrata	1.715	5.220	20.580	90.225	168.594	136.456	130.267	462.385	1015.442	35.5
5. Rest of species	100.664	173.441	153.383	138.395	121.916	82.992	45.485	236.748	1053.024	36.8
Total	219.299	279.251	262.845	358.216	404.969	316.533	195.985	766.168	2803.266	
Percentage	7.6	9.8	9.2	12.5	14.1	11.1	8.9	26.8		

Table No. 53

DISTRIBUTION OF VOLUME (IN '000' m ³) BY SPECIES & DIAMETER CLASSES (DHARIANAD - RANGE)										
SPECIES	Diameter Classes (C.B.) in Cms. at B.H.								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
1. <i>Anogeissus latifolia</i>	25.74	35.274	27.927	21.630	24.459	2.920	4.609	10.404	153,097	11.3
2. <i>Lannea coromandelica</i>	3.331	11.591	32.034	64.068	66.943	49.694	29.752	26.102	283,515	21.0
3. <i>Tectona grandis</i>	53.822	84.329	74.655	40.157	27.836	17.660	4.426	7.894	316,781	23.4
4. <i>Boswellia serrata</i>	0.502	0.456	9.218	8.305	40.385	62.882	53.892	72.465	248,105	18.3
5. Rest of species	42.986	50.607	46.956	38.423	37.145	44.400	34.453	57.360	352,330	26.0
Total	132.517	182.257	190.790	172.583	196.768	177.556	127.132	174.225	1353.828	
Percentage	9.8	13.5	14.1	12.7	14.5	13.1	9.4	12.9		

Table No. 54

DISTRIBUTION OF VOLUME (IN '000' m³) BY SPECIES & DIAMETER CLASSES (KUMBALGARH - RANGE)

SPECIES	Diameter classes (C.B.) in Cms. at B.H.										Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+				
1. Anogeissus latifolia	25.394	23.522	19.779	16.291	17.227	6.976	3.403	11.315			123.907	9.0
2. Tectona grandis	2.024	3.030	14.547	24.743	45.258	38.367	74.369	25.351			192.728	14.0
3. Tectona grandis	1.701	3.871	1.999	0.425	-	-	-	-			7.996	0.6
4. Boswellia serrata	5.402	12.378	22.672	53.893	80.563	107.488	91.707	154.869			538.972	39.1
5. Rest of species	49.469	75.374	63.421	52.021	40.196	35.646	19.864	179.246			513.237	37.3
6. Total	84.050	123.184	122.418	147.343	183.244	186.477	149.343	380.781			1376.840	
7. Percentage	6.1	9.9	8.9	10.7	13.3	13.5	10.9	27.7				

Table No. 55

DISTRIBUTION OF STEMS PER HECTARE BY SPECIES AND DIAMETER CLASSES OUTSIDE FOREST AREA.

SPECIES	DIAMETER CLASSES IN Cm. DBH.								Total	%
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+		
<i>Terminalia belerica</i>	0.105	0.105	0.055	0	0	0	0	0.105	0.370	0.4
<i>Anogeissus latifolia</i>	6.990	1.960	0.475	0.320	0.105	0	0	0.055	9.905	11.9
<i>Anogeissus pendula</i>	0	0	0	0	0	0	0	0	0	-
<i>Lannea coromandelica</i>	0.690	1.110	1.590	2.225	1.430	0.530	0.210	0.105	7.890	9.5
<i>Adina cordifolia</i>	0.055	0	0.055	0.105	0	0	0	0.105	0.320	0.4
<i>Acacia catechu</i>	0.690	0.160	0.055	0	0	0	0	0	0.905	1.1
<i>Wrightia tinctoria</i>	6.835	2.595	1.005	0.210	0.105	0.105	0	0.105	10.960	13.1
<i>Terminalia tomentosa</i>	0	0.105	0.055	0	0	0	0	0	0.160	0.2
<i>Tectona grandis</i>	7.625	2.120	0.690	0.105	0	0	0	0	10.540	12.6
<i>Boswellia serrata</i>	0.160	0.585	1.110	1.325	1.220	0.845	0.265	0.955	6.465	7.8
<i>Diospyros melanoxylon</i>	2.540	1.750	0.320	0.055	0.055	0.105	0	0.055	4.880	5.8
<i>Milusa tomentosa</i>	0.530	0.265	0	0.055	0	0	0	0	0.850	1.0
Rest of species	13.930	7.425	3.400	2.400	1.285	0.915	0.270	0.595	30.220	36.2
Total	40.150	18.180	8.810	6.800	4.220	2.500	0.745	2.080	83.465	
Percentage	48.1	21.8	10.6	8.1	5.0	3.0	0.9	2.5		

Table No.56

DISTRIBUTION OF VOLUME (m³) PER HECTARE BY SPECIES AND DIAMETER CLASSES OUTSIDE FOREST AREA²

SPECIES	Diameter Classes in Cm. BHOB.							App. Area 3100 km ²	
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40+	Total %
<i>Amorpha latifolia</i>	0.120	0.108	0.057	0.071	0.033	0.000	0.000	0.065	0.454 4.5
<i>Lansia coromandelica</i>	0.006	0.047	0.163	00.434	0.468	0.245	0.141	0.109	1.613 16.1
<i>Tectona grandis</i>	0.099	0.096	0.066	0.016	0.000	0.000	0.000	0.000	0.277 2.8
<i>Boswellia serrata</i>	0.002	0.020	0.118	0.259	0.426	0.435	0.172	1.330	2.762 27.5
Rest of species	0.309	0.592	0.453	0.459	0.385	0.436	0.158	2.143	4.953 49.1
Total	0.536	0.863	0.857	1.239	1.312	1.116	0.471	3.647	10.041
Percentage	5.3	8.6	8.6	12.3	13.1	11.1	4.7	36.6	